THE PROCESSING OF THREATENING PICTURES BY SPIDER PHOBICS USING A BORDER LOCATION TASK

BY

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Abstract

Processing of threatening pictorial material by spider phobics was investigated in three experiments employing a border location task. The task design enabled investigations of the distracting influence of spider pictures for arachnahpobics. To further assess the influence of the threat stimuli, trials varied in the contexts in which spiders were presented. Such contexts measured alterations in response speed induced by fear responses, attentional capture, or interference effects. Latencey to respond to the location of a border around one of four simultaneously presented pictures was measured. Experiment 1 revealed that i comparison with control subjects, phobics reported the location of a first border more quickly when it appeared around a spider picture. However, the location times of borders appearing around neutrally valenced pictures were similar to those of control subjects, even in the presence of a distracting spider picture. The task also required the location of a second border. In comparison with control subjects spider phobics again responded more quickly to borders appearing around threatening pictures, but also exhibited interference from the presence of a spider picture. Their location times to borders surrounding neutral pictures were greater in the presence of a spider picture.

Experiment 2 was inteded as a replication, and also by employing spider experts, sought to separate the effect of spider threat value from its relevance in producing the interference effects. No significant effects were found.

Experiment 3 sought to isolate likely factors contributing to the failure of Experiment 2. This suggested the failure of the replication lay in apparatus rather than design differences between the experiments.

Literature Review

Definitions

"Selective attention" as used in the current context, was proposed by Bower (1981) in the exploration of future "implications" of his network theory of emotions. Bower listed three sets of cognitive processes that could be influenced by emotion: - Associative processes, Interpretative processes, and finally - not as much a process, but its modification[1] - the Salience of mood congruous material. (See Table 1, Bower 1981).

The important ways in which emotion could influence stimulus salience were - selective attention to mood congruent material, priming and perceptual pop-out, and (less well placed in this set) selective learning of parts of narratives. (Also in the text of the article (p. 143) there was mention of a different aspect of the salience influences;- a lowered recognition threshold for self relevant information.) So for Bower, selective attention was an expression of the "mood congruency effect" that he had shown in previous research (Bower 1981). In proposing the concept of selective attention, Bower believed that "...subjects should actively attend to material consistent with their feelings."(Bower 1981 p. 142.) This principle was the crux of future experimentation by MacLeod and Mathews, and associates, (Mathews and MacLeod 1991, Mathews, MacLeod and Tata 1986, Mathews and MacLeod 1985) in relation to anxious subjects.

Selective attention, as described by Melara and Mounts (1993), refers to the way people remain occupied on a task while ignoring any distracting influences - implying conscious, or goal related action on the part of the individual.

[1]In MacLeod (1991), p608 the crux of the paper was that emotion influences not stimulus availability, but the control of systems acting on that stimulus.

Empirical evidence

Two reviews of emotional disorders have expressed detailed accounts of the differing trends in cognitive processing among anxious and depressed subjects (MacLeod 1990; and MacLeod and Mathews 1991). Anxious groups differ from controls only in encoding tasks - such as identification, and distraction from a primary goal. When anxious subjects have been tested on tasks involving elaborate processing and recall ability significant effects have not resulted (Watts et al , 1986; Ehlers et al, 1988), whereas such effects have been measured in depressed people. (Refer to table 7-1, p. 140 MacLeod & Mathews, 19

The above mentioned descriptions of selective attention focus on the conscious part of maintaining performance on a task, in the presence of distractions. The issue in this current work is to study the effects of threat-cues upon an anxious group - arachnophobics, in tasks that are extensions of the Stroop task. The studies mentioned will focus on selective attention in relation to the performance of anxious subjects on critical tasks, in the presence of threat relevant interference stimuli.

Automatically attended Danger signals, or Relevant stimuli ?

Two proposed mediators of selective attention form the basis of all reported studies. Firstly, the presence of a threat acts as a danger signal, producing an increase in "arousal", that results in preferential processing of the distracter stimuli.[2] The second proposed mediator of selective attention, is that the stimuli have to be relevant to the subject. In this instance the subject may be aroused by threat stimuli, but the essential factor is the familiarity, or previous associations with the stimulus yield a preferential processing of

[2] "Preferential processing" is unnecessarily complex jargon. The issue with tasks that are modifications of the task is that there is little else to do except respond faster or slower to the stimuli. The concept of "processing" surely relates to the stimulus-response chain, involved in vocal (and occasionally key presses) to stimuli. A more useful task would involve true interferences to cognitive operations, caused by threat stimuli. This will be outlined in the Discussion.

distracter stimuli. With respect to the current literature, there is a trend for authors to support the arousal hypothesis (in part), under the guise of state and trait anxiety influences (MacLeod, and Mathews ;1985). As will become apparent from the following section, more recent research considers stimulus relevance as the important factor in anxious subjects selectively attending to threat stimuli.

In studying the fundamental issues of selective attention, two main experimental paradigms have been used. These are - as noted by MacLeod (1991) - "identification" and "interference" tasks.

) Identification tasks.

These experimental situations involve the presentation of disguised, or degraded stimuli, and measuring the response time to - or number of correct detection's of - the stimulus. In his review, MacLeod (1991) noted two examples - hearing a word (threat) during a dichotic listening task where a noise was presented to occlude the stimulus, and secondly stem completion tasks. This type of paradigm was noted as being methodologically un-satisfactory, because the anxious group can have a response bias that increases their identification performance for emotionally relevant material. They may tend to over-report or guess in favour of material relating to their "mood". That is, the subject is giving *responses* that are concurrent with their current mood, in a way similar to acting in line with a demand characteristic, while their overall *detection ability* is actually lower. To avoid such methodological difficulties, tasks need to show that a threat stimulus can intrude on other cognitive operations, thus displaying an increased salience and importance of that threat stimulus. This can be achieved by using such stimuli as distractions from a critical task, which is the basis of Interference tasks.

ii) Interference tasks

In addition to Macleod's division of the two task types, additional design principles underlie the identification, and interference tasks. Identification tasks (mentioned above), involve a reconstruction process, where stimuli are affected by a self serving bias. Subjects recall stimuli that correspond to their beliefs in their emotional condition. Bower's tasks using conscious evaluations of situations, and passages of prose can also be described in this way.

Interference tasks however, are based on interactions of an additional stimulus (the distracter), and involve the real-time disruptions caused by processing that distracter stimulus. The two types of task appear to be distinguished by their levels of analysis. Identification tasks can be considered as based on language/communication and the personal relevance or "beliefs", while performance on interference tasks is based more on the processing of multiple stimuli.

When the relevant literature sources are analysed, two important distinctions become apparent within interference tasks, relating to the method of presentation of the distracter stimuli. When the task stimuli are presented as a single complex-stimulus, such as stimuli used in Stroop tasks, they are spatially concurrent. This then implies that the *processing* of the distracter stimulus, and the task stimulus is critical.

When the task and distracter stimuli occur in spatially separate locations, they are considered to involve different *attentional resources*, and influences. The distracter stimulus is operating beyond the domain (goals and strategies) of the task, and it interferes with task performance.

a) Selective processing

The majority of interference tasks demonstrating selective processing, have used the modified Stroop task. The modifications of the Stroop task have used the traditional primary task of colour naming , but have varied the words presented - the "to be ignored" information- to suit the types of subject groups being tested. Depressed subjects would be presented with depressing words, and anxious subjects presented threatening words, and each group would take longer to name the colour of words that relate to their psychological condition. This was the mainstay of selective processing experimentation, showing that more "Processing resources" are given to mood congruent material, as inferred by increased response latencies . The following studies are a small selection of these, (see MacLeod 1991; for a more in depth review).

Experiments assessing mood congruency effects, using Stroop tasks have included spider phobia (Watts, Trezise, & Sharrock, 1986; Watts, McKenna, Sharrock, & Trezise, 1986; Lavy, van den Hout, & Arntz, 1993), high trait anxiety students-prior to exams (Mathews & MacLeod, 1988), panic attack sufferers (Ehlers, Margraf, Davies, & Roth, 1988;) and general anxiety disorder patients, (Martin, Williams, & Clark, 1991; Mogg, Bradley, Williams, & Mathews, 1993; Mathews & Klug, 1993).

Watts et al (1986b), introduced the Spider Stroop, which they compared with five (Stroop tasks to investigate the influences of spider phobic anxiety on processing of threat cues. Of the several Stroop tasks the spider Stroop had a significantly larger effect, exclusively for the phobics, where they took longer to name colours of spider words. No differences were found for the controls. The crux of Watts et al's study was that the Spider-Stroop effect was reduced after sessions of desensitisation therapy. Because the effect of selective attention was modifiable, they proposed tentative reasons for selective processing, based on perceptual encoding, and attentional difficulties. These included the influence of phobia related arousal being influenced by the threat stimulus, and therefore giving rise to problems maintaining attention to the task of colour classification. (This is referred to as a "Secondary reactive process" by MacLeod et al)[3]. This reduction of the spider Stroop effect, after a therapeutic interaction was replicated by Lavy et al (1993). They used neutral and positive emotion stimulus words, compared to spider words. Again exposure therapy reduced this effect of delayed colour naming of spider words, in a second spider Stroop test completed prior to a desensitisation therapy session. This result is problematic, given that recent studies have claimed to have kept state anxiety, (and the levels of anxiety experienced within an experiment) to a minimum, and still yield selective attention effects (Ehlers et al 1988). Mathews et al (1990; p. 172) reviewed these and similar studies, and in addition studied recovered, and currently anxious subjects (using a different

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[3] The basic principle expressed here is that Anxiety is a disruptive state of affairs for the subjects, experientially, and cognitively

experimental paradigm to be discussed shortly). They concluded that reduced Stroop interference effects resulting from therapeutic interventions are not long lasting. Therefore, the Spider-Stroop effect may be linked to state arousal, as opposed to enduring alterations of cognitive structures. In the original spider Stroop, Watts et al mentioned that the words used as interference stimuli must be salient, or *relevant*, to a subjects mood or emotional state. Watts et al do not mention that the spider words used were relevant for phobics, but the neutral words were not able to be categorised as relevant for phobics, or controls.

Martin et al (1991; Experiment 2) attempted to study the influence of patient status on selective processing of threat cues, by comparing anxiety patients to equally anxious non-patient controls. The Stroop interference bias was found only for patients. Martin et proposed that patient status included self knowledge of suffering from an emotional disorder, or being in an emotional state. This knowledge could possibly translate into a vulnerability to threat, or a perception that they are in more danger (much the same as a form of priming), thereby increasing the salience of the threat stimulus . Presenting words that reflect "idiosyncratic beliefs" resulted in increased interference effects.

It was also found that words of a positive "emotional" nature similarly created an increased interference effect, relative to neutral words. The relationship between the two classes of threat and "emotional" stimuli is that each increases levels of "arousal". This appears to support Watts et al (1986), and Lavy et al (1993) who described alterations in state levels of fear as the mediator of the selective processing effects found on the spider Stroop task. More specific analyses of interference word emotionality have been conducted by Mathews & Klug (1993). To better study the influence of "emotionality", they created a Stroop task consisting of four classes of stimuli;-

(1) words relating to anxious and control subjects, that were of positive emotional valence ; (2) positive words not relating to the anxious or control people; (3) words un-related to either group, with a negative emotional tone; and (4) negative words relating to the anxious group only.

They found the crucial aspect is that the word type must be relevant for the subject, in that it is related ("semantically linked") to their current and/or likely "emotional concerns".

Control subjects performed similarly on all tasks relative to the neutral words . Anxious subjects however had larger interference response latencies - relative to neutral words, when the stimuli were either of the related type (1 & 4). Results indicated that an explanation of selective processing based on the *general* arousal produced from task stimuli having more "emotional" significance is not valid. Martin et al (1991; experiment II) could then be described as a case of the anxious patients having relevant words to view, whereas the equally anxious controls have nothing *personally relevant* to view.

In a masked Stroop, Mogg et al (1993) produced weak evidence in support of general arousal due to test stimuli being more emotional than control stimuli. They claimed that a "global and non-specific" bias occurs, to favour negatively valenced information, in situations where elaborate processing of stimulus material cannot be performed. To simulate such a situation, they used very short stimulus duration's in masked trials. It should be noted that the validity of their results was impaired by the type of analysis used, and the failure to replicate the usual interference effects. For example there were no content specificity effects as no effect occurred for depressed subjects, when viewing depressing stimuli- as is usually seen in Stroop tasks. An effect occurred only for the anxious subjects when a composite score was calculated. This was the average of the anxious and depressed words, made into an interference score and subtracted from the neutral stimulus interference score. This grouping of two affective valences has not been described before, and does not conform to the principles that propose differing processing systems/methods underlie depression and anxiety.

Evidence for stimulus relevance mediating selective attention, seems to best describe the experimental effects described above. Apart from Mathews and Klugg (1993) these reported experiments have a design fault, in that they lack relevant experimental stimuli for the control group. While threat stimuli are relevant for anxious subjects, they are not equally relevant for controls. Similarly no stimulus set is as equally relevant for controls, as the threats are to the anxious subjects This issue will be addressed in the second experiment of this Thesis, which tests arachnaphobics, and spider "Experts".

There are several concerns relating to the use of the Stroop task - and presumably its variants . Researchers have often considered the Stroop to be an example of difficulty in response output. As explained by Oleary & Barber (1993) the irrelevant attribute (colour name) acting as the distracter, is more closely related to the response - the verbal expression of the ink used to make the irrelevant attribute. This inter-relation between the two parts of the Stroop stimulus causes interference in the response chain, of reading the stimulus and reporting it.

It is true that response modality has a large influence on the outcome of Stroop interference. This was noticeably displayed by Melara & Mounts (1993; experiments 3). Responses were made on a response key, to stimuli carefully made to produce no colour or word effect. (How this lack of effect was achieved will be discussed shortly). Each half of the experiment had two colours to be classified, by pressing one of two buttons on a computer mouse. When these same stimuli were classified using verbal responses (naming the ink colour) a large effect resulted. Melara and Mounts were interested in more than different response modalities, and the effect different response types have on the magnitude of effect. Through the course of four experiments, they studied the dependence of the traditional effect on the difference in discriminability between the relevant, and irrelevant dimensions of the Stroop stimuli . Discriminability of stimuli was deduced from pilot studies where the sizes of each stimulus word were altered to equate reaction/detection time. So "....to equate the speeds of colour and word discrimination..." different heights and widths of visual angle were used for each stimulus. What could be obtained was a "dimensional separation", where the two dimensions of the complex stimulus can each be responded to, without a detrimental influence in task performance due to the other dimension's presence. When their individually designed stimuli were presented in a traditional experiment, the typical effects were removed; no slowing of responding occurred in either the naming of the ink colour, or the colour word. A baseline measure was also taken, that involved noting reaction times to one particular irrelevant stimulus dimension- ("RED" for example, in the case of a "colour") over all of the variations of its relevant stimulus dimension (colour of the ink). This average value could then be compared to the other response times of congruent (the colour of the word is its name) , and incongruent (ink colour, and word name differ) complex stimuli. Once stimuli were equated for discriminablity, the whole group could be made less discriminable along either the colour or word dimension. In their second experiment, Melara & Mounts made the colour dimension relatively more discriminable, by setting subjects further back from the computer screen, that the stimuli were presented on. This resulted in a *reverse* effect, where colour naming was facilitated for related words.

Their findings were that imbalances in stimulus design relating to one dimension, will produce effects in the other; - noticeable in a difference between the incongruent stimı compared to the baseline and congruent stimuli (which tend to both be equivalent). If an irrelevant dimension (say word type) is increased in discriminability, E.G. made larger, then interference in the relevant domain (colour) will occur.

Baseline discriminability is essentially the controlling - matching for - perceptual influences, and the visual impact of stimuli. This ensures that the task effect is due to semantic factors.

Generally these papers do not have *direct* bearing on the experiments being explored in this thesis, however, they did provide several important issues relating to the validity of the stimuli used. This will be discussed in the second section - the Introduction - but for now in remains to be said that - it may be necessary to (if not control for then to) keep in mind the need to equate discriminability of neutral and threat complex stimuli.

b) Selective attention.

Early experimentation on selective attention, by Clore, (cited in Bower 1981) involved displaying words in the centre of a screen that were opposite to a subjects mood - happy, or angry. These were surrounded by mood relevant distracter words. The intention of this particular experimental paradigm was to study the perceptual "pop-out" of mood relevant information, which would then interfere with the task of classifying the target word as being

ERRATUM.
(GRAMMATICAL)

Page:	Line :	Should read-
2	5	"been tested on tasks... elaborate processing, and recall ..."
2	8	"The **previously** mentioned descriptions..."
2	footnote 2	line 2 "modifications of the **Stroop** task is ..."
4	1	"using conscious... situations, and **recall for** passages of ..."
7	25	"to the anxious subjects**.** This issue ..."
8	16	"where the sizes of ... reaction/detection time. So**,** "to..."
9	5	"produce effects in the other - noticeable **as** a difference..."
10	12	"stimuli were 2.1°). The spatial **Stroop** task was compared..."
13	13	"performance. The use of **an** "attentive" strategy ..."
18	5	"of attentional variations. __ There is a better chance of ..."
21	28	"by verbal responses could not... as specific data **that** are..."
23	6	"**positions**, even if the array search..."
24	18	"___ a picture of a spider and three..."
29	13	"set **(Everyday items)**, and the plant and flower pictures formed the second **(Flower)**.
30	3	"classes of interference. **Both** location **times are therefore** treated as a single interference category..."
33	14	"(and, **numbers 1-72** on line one of Table 1.)"
40	17	"is not statistically...This, **however,** implies that the..."
42	20	"The Dunnett's test **(for the phobic data)** revealed that..."
63	1	"subjects **on** the first border."
66	12	"used as peripheral **stimuli.**"
69	8	"**For second border location times,** the phobic group ..."
69	10	"condition when... absent. **This is represented** in Figure 18."
74	5	"sheet. Spider phobia rating... the four**-**picture, and..."
80	1	"12" Monochromatic screen. This__ increased curvature..."
80	11	"Second border response times **conformed to a** consistent **pattern** throughout experimental tasks, although..."

either "happy" or "sad". Intrusions by the surrounding, mood congruent words would be noted by delayed responses, and increased errors in classifying the centrally placed word. Apparently only a small effect was obtained, but it indicated a pop-out effect.

Even from this early experiment the trend for a different focus of study can be seen. The obvious differences in the selective processing, and selective attention experiments are due to alterations, and modifications of presenting the distracter and task stimuli. The current experiments can have differing stimulus presentation styles, which can be described basically as - the separation of the task and distracter stimulus dimensions either spatially and/or temporally. From this new design the two main mediators posited to cause selective attention/processing effects can be more carefully controlled for and studied. State an: influences can be controlled for, and a fine-grained analysis of stimulus relevance can be employed.

Fox (1993) produced a study attempting to assimilate, and "separated stimulus" studies. By presenting the same distracting stimulus (a colour-, threat-, or neutral- word) above and below a centrally placed colour bar, she created a spatially separate colour naming task. This intended to discover whether the distracting effect of the words, could still hinder response latencies if the array was visually larger than the usual 1°-2° of visual angle - (her stimuli were 2.1°). The spatial was compared to a traditional form, to openly show if the spatial version worked. This experiment paralleled Broadbent et al 1988; in that it used normal students, that were later divided into high and low trait anxiety groups. For the traditional, both high and low trait anxiety groups displayed the usual colour interference. For the Low anxiety group the threat and neutral stimuli were no different in their power to influence colour naming; and for the High anxiety group threat words interfered more than neutral words, but not as much as the colour words. In the separated the Low anxiety group performed equally well in the presence of all three distracter word types. The High anxiety group however repeated the pattern shown on the traditional, i.e. colour words interfered more than threat words, which interfered more than neutral words on the colour naming task.

Fox concluded that high trait anxiety subjects performed poorly on each of the tasks because they are unable to maintain an attentional focus on the task. This point is not accepted by Mathews , May, Mogg, & Eysenck, (1990) - a paper soon to be discussed.

This reported effect could however provide evidence of the need to control for baseline discriminability, and do present one stimulus per trial. When the stimuli are presented as a group on a card which subjects must read through, it is possible that a strategy can be learnt. The coloured bar target stimulus, is more discriminable and can with practice result in increasingly more attention being directed to the bar, than the words appearing above and below it. Separate stimulus presentations per trial, on a (computer) screen, may yield different results, because the influence of the words will be increased.

MacLeod Mathews, and Tata (1986) designed a single trial stimulus presentation task, having a *temporally* separated distracter stimulus. This experiment provided evidence that the presence of threat material relevant to the subject's mood, can detract from, or aid performance on a central task. The task created was the "Dot-probe" paradigm, where two words of varying emotional valence (neutral or threat) were presented one above the other, in the centre of a screen. Subjects were instructed to read the top word. The words were removed from the screen, and subjects waited to respond to the appearance of a dot , appearing in the position that one of the words had occupied. The dot occurred on only one third of the trials. The associated responses were either pressing a response button to signal that the dot was seen, or a time out if no dot was displayed. [4] For anxious subjects the detection of the dot probe was faster if the dot appeared in a position previously occupied by a threat word, and slower if in the other position. Control subjects on the other hand detected the dot-probe faster if it followed the neutral word. It was assumed that the threat (mood relevant word) lured attention into the region it was presented in, thus allowing quicker detection of dot probes sharing this location, and delayed detection of probes in the other position. (MacLeod et al preferred to describe the effect produced by the controls as attention moving "away from" the threat-cue.)

[4] It is necessary to return to the issue of the anxious word action as a cue for responding. This was noted by Broadbent et al (1988), in his modification of the dot probe experiment. It has a bearing on the present Thesis Experiment, as in the soon to be discussed tasks, the experimental probe always occurs.

Replications of the dot-probe task have supported the principle of stimulus relevance. Mathews and MacLeod (1988) replicated the dot probe experiment effects, using medical school students. They were tested both 12, and one week before a major examination. Subjects were divided into low and high trait anxiety groups. The stimuli used for the experiment were exam relevant and irrelevant threat words, and neutral words.

Aside from the tenuous support this replication evidenced, there have been successful tests of the dot probe paradigm. Broadbent and Broadbent(1988) tested people drawn from the general population, and compared their trait anxiety scores (measured on the Spielberger Trait and State anxiety scales). Only correlational analyses could be performed to discover the effects of state and trait anxiety on performance. These calculations supported the notions of MacLeod, and Mathews, that *trait* anxiety is the prime factor correlating with an observed bias to attend to threat cues. State measures did not appear to have a bearing on the attentional bias. They also controlled for the possible effect that threat words acted as cues that the probe was to follow the word termination. The dot-probes occurred on 1/3 of the trials in Mathews et al's experiment, but Broadbent et al increased the probability of dots occurring. There were no effects for neutral or threat stimuli, so the words were not cueing the imminent occurrence of a probe trial. An important new measure was introduced in this experiment; the measuring of dot-probe detection latencies for "filler" (neutral) words . This provided a useful baseline, allowing a better description of the effects of threat words on probe detection. These data could now allow relative differences in responses to neutral and threat stimuli to be inferred. The results show relatively small effects when expressed graphically, except for one condition. When the threat is where high anxiety normals were told to look to read the stimulus words, the effect of speeding is dramatic.

It may be concluded from these studies that the dot probe task measures a replicable effect, based on high *trait* anxiety subjects over responding to *relevant* threat stimuli.

More recent studies have investigated the effects of the emotional valence of distracters, using lexical decision tasks involving either word or letter identification. Mathews et al (1990) specifically addressed the question of whether anxious subjects' performance on selective attention tasks is due to an attentional deficit, or the relevance of the distracting stimuli. They conducted two experiments comparing currently anxious, and recovered anxiety sufferers, with control subjects. The two tasks varied in distracter material, and the strategy needed to perform the task. They found that the presence of distracters did not interfere with the three groups performance on either cued location letter detection, or un-cued letter detection tasks. This supported the notion that a general attentional deficit in anxious subjects could not explain task interference results.

Different results occurred in a second experiment, that used more complex stimuli in which words were both the items to be detected, and the distracters. When no distracters were present, all three groups performed at much the same level. Significant effects were only seen when the stimuli to be classified had to be "searched for". The interference caused by the *threat* words resulted in the currently anxious, and recovered subjects showing increased response latencies, compared to controls. However when *non-threat* distracters were presented, recovered subjects responded as fast as control subjects, while the currently anxious subjects were distracted more, and so responded slower. These results were interpreted as an indication that a search was a necessary prerequisite for distracters to have a disruptive effect. Given that cued tests did not result in anxious subjects being distracted by threat stimuli it would appear that the pop-out effect described by Clore does not always occur. The threat stimuli appear on an experimental trial, but do not interfere with task performance. The use of a conscious "attentive" strategy overpowers this "perceptual" influence. [5]

MacLeod & Mathews (1991) obtained underlying methodological principles used in previous selective attention research, and concluded that the essential design parameter was the simultaneous presentation of more than one stimulus -each of different affetive valences.

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[5] This point will be seen to be very important in the discussion of the present results - for experiment one.

Reaction times to single stimuli (one picture of a threat event, versus a neutral event picture) resulted in no performance differences between anxious and control subjects. Selective attention occurs if two affectively valenced stimuli are presented simultaneously - as in the dot-probe experiment where one word is in the upper area, and the other in the lower area. This shows how one alternative can be selected, or rather cannot be ignored and, according to MacLeod and Mathews will be processed faster.

MacLeod & Mathews (1991) compared the lexical decision latencies, for words (of either a threatening, or not-threatening nature) and non-words, in two experiments. The first study compared the decision times of anxious and control subjects, on a standard lexical decision task. No significant differences were observed. Two arguments can t expressed to claim that this task - the Single stimulus trials are in effect a discriminability check. Firstly no significant effects were found between group response latencies, so it would appear that the words were matched in discriminability, just as Melara & Mounts (1993) recommended stimuli should be. Secondly, the argument proposed earlier, based on the experiment evidence, is that in the attentional paradigms, it is essential to have two stimulus attributes, (or two stimuli) present, to create an analogue of the complex stimuli used in tests. A single word presented on a trial does not satisfy this criterion. It may, however, be argued that when single words varying in emotional valence are presented, there are two stimulus dimensions - the relevant dimension which is held constant as a monochromatic word, and the irrelevant dimension is the variable word valence. The Single string task can be considered as a discriminability test for the words, so the validity of this task as a test of selective attention does seem to be reduced. The use of these results as a discrimination check is however very valuable.

In the second task, MacLeod and Mathews presented trials where either a threat, or non-threat word appeared simultaneously with a non-word. This resulted in a significant effect, of the anxious group reaction times differing greatly from controls. MacLeod and Mathews concluded that in order to produce a selective attention effect favouring the influence of relevant (threat-relevant) distracters, two sources of differently valenced information must be simultaneously presented. They chose valences conditions of threat, non-threat, and a neutral condition of non-words. This usage of two stimulus options allows a "decision mechanism" to set a priority of which stimulus will be processed first. According to the model used by MacLeod and Mathews (found in Williams, MacLeod. Watts, and Mathews 1988) this results in the processing of the threat information before any other information. To quote their paper ".. anxiety is ... associated with a disproportionate processing advantage for threat-related information, relative to neutral information ..."

This phrase "... relative to neutral ..." needs clarification. If the data from both experiments (presented in their Figure 1) are expressed as a single graph, and the single string stimuli considered a baseline condition, then the data imply equivocal, and ambiguous trends. (See Figure 1). Do the response times of the anxious group actually indicate a response *speeding*, towards the threat stimuli relative to the neutral stimulus detection time, or, is the neutral stimulus detection time *slowing* relative to the single string trials ?

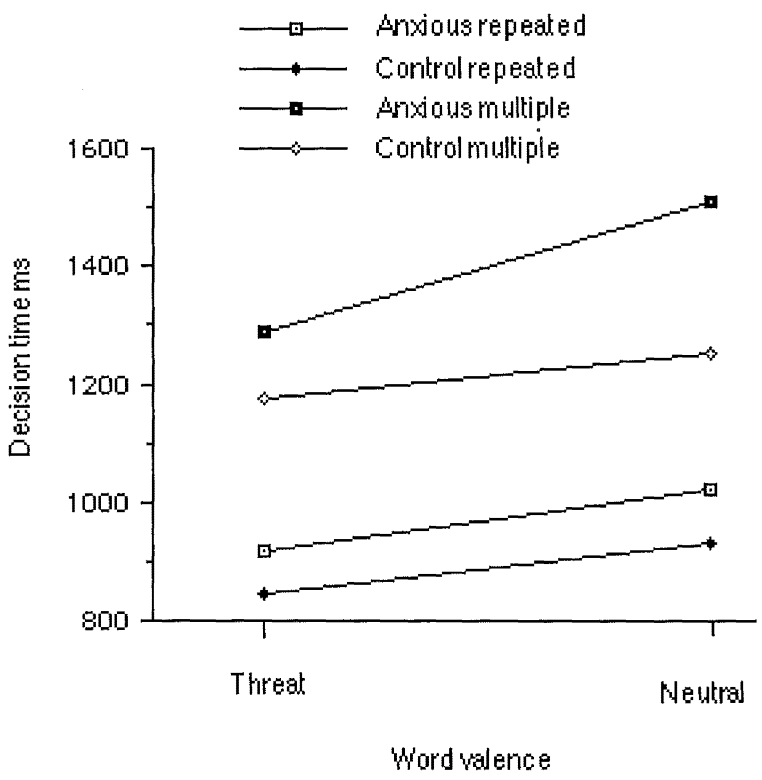

Figure 1. A re-presentation of the data from MacLeod and Mathews (1991), showing the response times of phobics, and controls to single and double word strings, on the dot-probe task.

This experiment is similar in part to Mathews et al (1990) where the introduction of the need to search the display enables the disruptive influence of the distracter stimulus to be observed. Using their reasoning, in the current experiment by MacLeod and Mathews, the use of threat words should have resulted in *faster* lexical decisions for threat words. Unfortunately MacLeod and Mathews did not report the data for non-word stimuli. This could have resolved the problem of which stimulus type was causing the difference - of speeding to post-threat probes, or slowing to post-neutral probes.

Additional improvements to the experiment would have seen the presentation of multiple valences of threat and neutral words appearing on the same trial, and the single string (prioritising) trials could have featured the same word presented twice on a trial stimulus. This would provide an experimental situation similar to Fox's (1991) presentation of the Separated task, where the same word appeared above and below a central colour patch.

INTRODUCTION.

The aim of the present study is to explore why anxious subjects show distraction effects to threat stimuli, in interference tasks. Does the threat stimulus alert the subject, and induce a generally aroused behavioural state, or is there "pre-emotional" prefferential procesing of the threat? In order to explore this, arachnophobic subjects were chosen to act as the anxious group. Several reasons justify their use as an analogue of anxiety sufferers. Using such a tightly constrained and common phobia, provides a better means of producing relevant threat stimuli. (Full descriptions of stimuli are in the method section, and Appendix 2.) Similarly, the available people in the population is small, yet easier to obtain than clinically anxious subjects, such as generalised anxiety disorder patients. It has been mentioned in behaviour modification text books (Masters, Burish, Hollon, & Rimm, 1987) that the use of snake, spider, and needle phobic anxiety disorder patient analogues, are a tenuous link to true anxiety disorder patients. There is however, only a small amount of relevant literature studying arachnophobics, so they are deemed relevant subjects for the study of a selective attention experiment.

To aid understanding of the processes that resulted in the design of the present Experimental task, a brief description of the task is necessary .

The Basics of the Border location task.

The critical experimental task was to report (via a key press response) the location of each of two squares, that appeared successively on a computer screen. Various distracter pictures were also presented in the corners of the screen, placed inside the positions where the squares appeared. To further aid their distracting influence, the pictures appeared shortly before the squares . The types of distracting stimuli were pictures of spiders (threats); plants that looked like spiders, flowers, everyday objects (which were of a neutral affective valence); and sad people/scenes (dysphoric valence). Four distracting pictures appeared together on each trial. By varying the picture probed (surrounded by the border), it was possible to study the distracting influence of various affectively valenced pictorial stimuli.

Pictorial stimuli were chosen because they were believed to allow a level of abstraction , and naturalism necessary for assessing aspects of pre-conscious attention, and other effects of attentional variations. As noted earlier there is a better chance of visually similar controls for pictorial stimuli - the Spider pictures can have a visually similar control category of Plants. Experimental support for the validity of using pictures in preference to words was obtained by De Houwer, and Hermans (1994). They conducted a Stroop task involving complex stimuli made of picture and a word presented spatially concurrently, on each t and concluded that pictorial stimuli are better affective stimuli for use in affective processing tasks. Unfortunately their experimental design was seriously flawed. They did not match the discriminablity of the task, and distracter stimuli.

Preliminary research, conducted by MacLeod's research team did not produce selective attention effects when presenting single pictures of anxious situations (MacLeod, 1990, Ch 2). It is relevant to study the validity of such stimuli within the area of selective attention.

Watts et al (1986) presented concrete stimuli when they used dead spiders, and parts of spiders, mounted on cards for a test of the effects of elaboration on memory for phobia related material. The current experiment follows on from Watts et al, using naturalistic stimuli, but enables a larger number of spider stimuli to be presented during sessions, and within more complex contexts. Three experimental threat contexts were used in the present experiment - threat stimuli directly probed, threats present on trials but not probed, and no-threat present.

The pictures presented on a computer screen, are obviously closer to a natural situation, and can bridge the distance between single word stimuli experiments , and naturalistic events relating to anxious threat-cues. This is another experimental need proposed by MacLeod (1990, Ch. 7).

By having pictures computerised, experimental demands for invariant stimulus sets are satisfied (Fox, 1993; MacLeod et al, 1991). The spider pictures are suitable threat stimuli because they are a negatively valenced stimulus (threat) for all subjects. People who do not fear spiders do not tend to say that spiders are pleasant and relaxing . Even spider experts who have no fears of spiders tend to treat them with respect, and be aware of the danger some of them can present. Therefore the spider stimuli can be considered to be a sufficiently threatening stimulus - varying in threat value for different people.

The current experiment was designed to be an expansion of the "dot-probe" experiment. It intended to clarify some of the issues relating to whether attention to threatening distracters results in the speeding, or slowing of responses to probes occurring after either threat or neutral stimuli.

The first issue to resolve in MacLeod et al's (1986, 1991) studies is - did the attention of the phobic subjects move to threat words, or did it move away from the neutral ones. If attention was captured by (or drawn to) the threat cue then it will obviously be detectable in faster reaction times to the (temporally separated, spatially concurrent) probe stimulus. However without a baseline condition, no understanding of relative change (speeding, or slowing) in reaction time, can be ascertained.

Measuring response times for a no-threat (baseline) condition, in addition to an affectively neutral condition would provide the necessary distinction for assessing whether threat stimuli were being responded to faster.

For the present experiment four concurrently presented stimuli were used (so displaying up to 3 emotional categories). The stimuli would be concurrently displayed, yet still have separate stimulus dimensions, because the distracter stimuli appeared before the experimental probe border, and the position the border would assume was one of the four corners. [6]

In addition to assessing general detection speeds - and Perceptual "pop-out" (via first border location responses), presenting multiple stimuli allows measuring a second response

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[6]Admittedly spatial separation does not occur in the current task. Temporal separation of a sort does occur , because the probe onset occurs 500 m.s. after the irrelevant stimulus onset; and secondly the probe instantly re-appears in a second position after a response.

on the same trial. This allows the influence of shifting attention from stimuli of differing emotional valences to measured.

Most importantly, it is argued here that the dot probe experiment does not actually test for any *interference* aspects - where task performance is disrupted by the simultaneous presence of an irrelevant distracter stimulus. The dot probe task only creates a situation where subjects "dwell" on mood congruent and/or relevant, stimulus material. The present experimental task is able to measure if subjects *dwell* on the relevant (threat) stimuli. This test for dwelling is more precise, and more explicitly verifiable than previous research attempts (Martin et al p. 159, 1992; Fox 1993). The dwell influence will be directly observable from comparisons with the reaction times of neutral stimuli - those categori stimuli not including the threat and dysphoric pictures. Attention may "dwell" on the threat stimulus used for first border responding, and result in longer response times to the second border, than occur after neutral first border stimuli. In the current thesis this is a major effect under test.

To create stimulus situations where the influence of emotional valance can be analysed within different threat contexts, three or more stimuli need to be concurrently presented - neutral, threat, dysphoric, and a threat-control. These can then be combined to create complex stimulus arrays that vary in their level of threat context - no threat ; threat in background (interference); threat as target (threat). From these different contexts (Probe conditions) the distracting influences of threat stimuli can be assessed. Spiders could cause either speeded , or delayed border location responses depending on their location in relation to the area that the probe occupies. These different levels of threat context also allow the assessment of the influence of the two guessing strategies mentioned by MacLeod (1986; 1991). Firstly, reaction times may be slower if the presence of the threat stimulus produces a secondary reactive process, where the subject introduces another processing and/or behavioural stage to the task. This can be tested using the present task by comparing the probe location time for a border around a neutral stimulus on trials which contain an unprobed spider with those on trials containing no spider. If the presence of a threat stimulus causes general slowing of responding, then it may be due to the threat altering state anxiety levels, and causing avoidance behaviours (such as drawing their hands to their chest in a typical disgust and/or retreat "reflex".) Alternatively, the presence of a threat could induce faster response times if it makes an escape response necessary. Secondly, it may be that subjects defend against the background threat by introducing a strategy to ignore it, thereby again delaying responses - compared to neutral situations. This is known as "cognitive avoidance".

If perceptual pop out occurs, where subjects are always pre-consciously predisposed to - and "automatically" view threats, then the detection of a neutral target in the presence of a spider will be a slower than the reporting of a border around the same neutral picture i threat trials.

Alternatively if a *strategy* is used where threats are responded to faster only when they are targets , then differing threat levels and/or contexts will not interfere with neutral stimulus categorisations. If response times are generally faster when a spider is present, a "search" mode may be initiated, for one of two reasons. Firstly the presence of a threat, may induce a general unconscious "hyper-vigilance" response style on the part of the anxious subjects; and secondly it may be a general meaning/context resolving goal that all subjects need to perform.

It becomes apparent that having multiple stimuli and a concurrent experimental probe, allows a better analysis of the concepts of "speeded" responding to- , or preferential processing of- threat stimuli, and the true concept of "Selective attention".

Further arguments against the Stroop effect is that there is a discrepancy between stimulus and response compatibility. This conclusion was given by O'Leary, and Barber (1993), in discussing selective attention in Stroop (and Simon) tasks. Due to the difficulty in fulfilling the demands of the primary task, when the irrelevant task has a low degree of stimulus response compatibility, the translation of the two tasks causes the interruptions, (and thus results in the response latencies) found in Stroop experiments. The design of the current experiment needed responses to be directly related to the layout of the task and distracter stimuli. Key press responses were chosen because they were most practically implemented to the multiple concurrent stimulus displays. Four location responses, assessed by verbal responses could not be as easily measured or produce as specific data as are obtainable by key presses.

However key press response measurement may cause a situation were responding to the threat-cue is delayed, because it is in a sense associated with touching the threat stimulus, (this is again a form of avoidance response that may interfere with responding)[7].

Considerably more important than the type of response measured, is the fact that all Stroop tasks are based on alterations in response speed. This does not control for the influence of arousal, as expressed when fear results in more hurried responses. Becai the increased affective value associated with pictorial stimuli, they risk increasing arousal, and influencing response speeds. The previously mentioned tasks all suffer from this methodological flaw.

To fully test the idea that phobic stimuli do not produce increases in encoding/storage of information - and thus no improved recognition memory, subjects were given a memory test at the end of the experimental tasks.

SUMMARY

By studying trends in experimental designs, it was possible to see what is needed from a task to produce a selective attention experiment, that could improve upon Mathews et al's dot-probe experiment. This improvement was expected to be obtained by concurrently presenting two different negatively valenced stimuli (threat and dysphoric), and two neutrally valenced stimuli, with a simultaneously present and similarly positioned experimental probe. Because the response keys matched the layout of the stimuli, alternative explanations - such as stimulus-response incompatibility - can be ruled out. Such complex stimulus presentations could also control for response strategies, such as i) secondary reactive processes, and similarly, ii) that when discriminability is equal for the neutral and interference cards, it may be seen that searching for the target is the selective

[7]In the course of all 3 experiments, only one subject ever did this.

attention effect mediator. This improved discriminability is achieved by the use of pictorial instead of the usual word stimuli. The design of the experiment may also illuminate how attention alters task performance in various ways.

In order to improve on MacLeod and Mathews (1991) single string experiment four identical pictures were drawn on each card. These "Repeated picture" trials, still use processing priorities because there remains the need to track the probe stimulus on both moves, even if the array search is simplified-with there being rep[lications of only the one picture to search. Because of the two boarder location task, the experimental trials can be considered as more than a detection, or discrimination test. This analogue of the single string stimuli, produces a better recreation of a situation where priorities do not have set.

Selective attention in anxious subjects appears to be an early stage process, where threat-related information receives more attentional orientation, faster detection, and increased salience (shown by inability to ignore it) (MacLeod 1990 p47). MacLeod et al (1991,1986) propose that threat material acts upon the performance of an anxious person in a way suggesting that a threat influences a decision mechanism, causing the threat to "capture the selective system" and give the threat preferential, and thus apparently faster processing. In the following experimental situations, stimuli consisting of differing emotional valances (threat, neutral and dysphoric) were displayed. This appears to be a comparative effect that multiple valenced stimuli need to be presented so that decisions of priority can be resolved, to favour earlier processing the threat material . Additionally in experiments utilising words as stimuli, the words would appear to have to relate to the subjects "emotional concerns", (or be personally relevant and meaningful) for this effect to be strongly seen.

EXPERIMENT 1

The present experiment involved subjects responding to a stimulus array consisting of four pictures, each located in the corners of a computer screen. Each screen presentation (referred to as a card) consisted of the pictures, and two additional stimuli subsequently drawn around two of these pictures. These additional stimuli were a square border that appeared around one of the pictures at a time. The primary task was reporting the border's location, by pressing a key corresponding to the layout of the four pictures. Once a response was made, the border was removed from its position, and a second drawn a one of the remaining three pictures. A second response describing the border's location was then needed. Once both responses were made, the card was removed and the screen cleared. Then a new card was displayed, and the process repeated, until both borders on all 168 cards were responded to correctly.

Pictures were used as distractions from the border locating task. To further aid their distracting influence, the pictures appeared shortly before the first border. The pictures were of two emotional valences- threat (spiders), and neutral (plants that looked like spiders, flowers, and everyday objects). Dysphoric pictures appeared on the cards but were not surrounded by any of the borders, and therefore are not an issue in the current context.

Three types of card were presented. These were Multiple valence cards which displayed cards containing a picture of a spider and three neutral pictures, Neutrally valenced cards on which there were four neutrally valenced pictures , and Repeated picture cards that had one picture repeated in each corner of the card. The distracting influence of spider pictures was expected to have two effects on the border location times of phobic subjects. When a border appeared around a spider picture , attention would be captured, and phobics should be faster at reporting that border position. When responding to a second border, after a threat has been probed by the first border, the response time would be slower for phobics. Control subjects would not be influenced by the threat, and respond at a constant rate, irrespective of picture valence.

In anxious subjects, threat-related information is believed to receive more attentional orientation, faster detection, and an increase in salience shown by an inability to ignore such material (MacLeod 1990 p47). MacLeod et al (1991,1986) propose that threat material is acted upon by an anxious person in a way suggesting that a threat influences a decision mechanism, causing the threat to "capture the selective system" and give the threat preferential, and thus apparently faster processing.

To allow a decision between stimulus valence, more than one affective valence needs to be presented on each trial. Fox (1993) mentioned that when only two stimuli, of differing valence are presented (as in the dot-probe task), a conscious strategy of switching atter between the two stimulus locations could produce the obtained selective attention results. In the present experiment four stimuli are displayed, that have three emotional valences (threat, dysphoric , and neutral items.) The four stimuli are presented for the same pre-probe time of 500 ms, used in the dot-probe experiment of Mathews et al (1986). The present experiment has several features that should reduce the possibility of an overt scanning strategy. Firstly trials in the present study display twice the number of stimuli used by MacLeod et al, and secondly the stimuli are separated by a much larger visual angle. Subjects were also instructed to look at the centre of the screen where a fixation cross appeared, and to keep their gaze there. Even having the subjects gaze stationary, does not rule out the possible utilisation of a form of pre-conscious covert attention allocation, where an analogue or mental representation of the card is scanned. Alternatively, if seeing threatening stimuli arouses the phobics, and induces a conscious scanning strategy, it is possible this would increase the general level of response latencies. Admittedly both groups could begin to scan the arrays, but according to the arousal based explanations of selective attention, the phobics are expected to be more influenced.

Given the more demanding stimulus layout in the present experiment, the pictorial stimuli have several advantages over word stimuli. Firstly simultaneously presented words cannot of themselves initially "capture" attention, because they have a level of abstraction that separates meaning from their perceptual form. Pictorial stimuli have an immediately apparent meaning, although verbal labelling or categorisation may occur at a later stage of processing. Secondly pictorial stimuli are more universal in that they can be used with subjects of differing intelligence levels, and cultural (language) backgrounds. While pictures may still have ambiguous meanings, their comprehension should be easier than the comprehension of words.

The last 72 cards shown in Table 1 are an analogue of the single stimulus presentation trials of MacLeod and Mathews (1991). The repeated picture cards have a single affective valence , and therefore no attention priority selections need to be performed on them. Under single stimulus conditions, all the proposed reasons for selective attention effects predict no response differences will be shown by phobic subjects to threat stimuli, (providing tha stimuli are equally discriminable). A card presenting more than one occurrence of the stimulus would create a situation where only a reduced stimulus-layout search strategy would be necessary for a subject to "know" that no priorities for attentional allocation have to be made. The use of the same stimulus picture repeated on a card is a preferred strategy for studying a situation where *priority selections* are not necessary, but where a *search* might be.

Hypotheses

Three hypotheses are under test. Firstly , only the phobics will respond faster when the borders appear around spider stimuli. This will evidence the currently accepted theories that attention is allocated to threat material by phobics (MacLeod et al 1986; 1990; 1991). Similarly the presence of a spider in an area not relevant to the primary task (filler stimuli) could be expected to interfere with, and slow the primary task performance. It is arguable that the Dot-probe task did not fully test this idea.

Secondly, it is proposed that phobics will dwell on threat stimuli probed by the first border, and will take longer to report a second border appearing around neutral stimu This concept was hinted at by the underlying principles of the dot probe experiment (Mathews et al 1986), and first discussed as an overt aspect of experimental design by Fox, (1993), but to date no published research has used a task capable of directly testing both the capture, and dwell influences on attention caused by threat stimuli.

The third hypothesis is that on repeated picture card trials all subjects will respond at the same speed to all borders, regardless of the picture valence. Previous work by MacLeod and Mathews (1991) found that alterations in response speed to threat stimuli occur only when there are stimulus alternatives that compete for priority of attentional allocation.

An additional part of the present experiment is the inclusion of a recognition test, to show that phobics do not remember significantly more threat stimuli than controls. Groups should be equal in their recognition memory performance. This will provide evidence for the theories that the processing of threat stimuli is at an encoding phase, not an elaborative one. Previous research testing spider phobics on interference tasks (Watts et al 1986; Ehlers et al 1988) has found the phobic groups retention of threat stimuli has not been larger than that of controls. The mood congruent memory biases predicted by Bower (1981), have not therefore been supported.

Method

Subjects

Eleven arachnophobic subjects, nine of whom were women, were tested. The phobic subjects had a mean age of 21.3 years. Their average phobia score was 24.4, as measured by the Dimensions of Spider Phobia questionnaire (Watts, & Sharrock 1984). Ten further subjects (eight women, and two men), mean age 22.55 years who scored on average 6.44 on the phobia scale, served as controls. All subjects were recruited from a first year psychology student volunteer subject pool, at the University of Canterbury.

Stimuli

As explained earlier, four pictures appeared on the computer screen on each trial, tw which were surrounded by a border. The border was a 50 mm wide unfilled black square, drawn as single line thickness of approximately 0.75 mm .

The pictures were 64 black and white (shaded) line-drawings. Each picture was produced by using a "Scanman" digital scanner to scan either directly from a book illustration, or from tracings of photographs. Apple Macintosh "Superpaint version 2" artwork software was used to reduce the size of the image to approximately 45 mm^2, and to remove or shift detail of the picture to improve the image quality.

Six sets of pictures were used.

Threat . (S) These stimuli were 12 pictures of New Zealand spiders, based on the drawings in Forster ,1979.

Plant (P) This category of stimuli were 12 pictures of New Zealand plants that looked similar to spiders. These pictures were alterations of drawings in J. Mathews, (1986) gardening book. They were expected to act as a visual control for the spider pictures, and be as visually complex and as homogeneous a group as the spider picture category.

Dysphoric (D) These 12 stimuli were expected to describe experienced situations that were depressing. Pictures were variants of drawings of photographs in psychology text books. (Atkinson, Atkinson, Smith, & Hilgard, 1987; Rosenban & Seligman, 1989.)

Everyday items (E) These 12 pictures were chosen as having a neutral affective valance. They were of household objects, animals, and people. Copies of photographs, and sketches of objects, pets, and people were used. These pictures were taken from magazines, and the experimenters personal photographs.

Flowers (F) A further 8 pictures, chosen on the basis of not looking spider like made up this category. These were also sourced from J. Mathews, (1986), and were assumed to have a neutral affective valence.

Objects (O) These were the final category, of eight objects also having a neutral affective valence.

Flower and object picture categories were used as control stimuli because they shared a perceptual, and conceptual similarity with the plant, and everyday items respectively.

Category grouping, and valence assessment of the pictures was determined t experimenter in consultation with two phobic family members, and a close friend who was not afraid of spiders. The method of selection involved their choosing the best 12, from a page of 15 pictures. This always yielded the same 12 best pictures.

Design

Stimulus cards and experimental conditions

A total of 168 stimulus cards were constructed, and used as the basis of each experimental trial. One card appeared on the computer screen per trial. Cards consisted of a combination of four pictures, one picture in each corner, separated by 10 cm between centres. Also on each card, two sequentially presented square borders were drawn. The two critical pictures on a card were the two that were "probed" when surrounded by the square border. The other two pictures were "fillers".

Card types were classified with respect to the category of the probed neutral valence stimuli. The everyday item, and their related object category pictures were the first card type set, and the plant, and flower pictures formed the second.

Cards also varied in their picture combinations, or "probe conditions"[8]. For the first border presentation, there were four probe conditions, threat, interference, no-threat, and repeated picture (shown in the second column of table 1).

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[8]Because different stimuli were used for the different card types of no-threat card, and the spider inclusive threat and interference cards, the terms "picture stimuli" and "probe conditions" are in effect interchangeable. This problem was rectified in the next experiment, when the same picture categories appeared in each probe condition.

Table 1. Key to which pictures appear in the card arrays, for Experiment 1.

card number	First probe condition	first border [1]	second probe condition	second border [2]	filler stimuli i	filler stimuli ii
1 - 12	threat {T}	Se	dwell {D}	sE	d	p
13 - 24		Sp		sP	d	e
25 - 36	interference {I}	Es	threat	eS	d	p
37 - 48		Ps		pS	d	e
49 - 60		Ep	interference	iP	d	s
61 - 72		Pe		iE	d	s
73 -84	no-threat {N}	Fo	no-threat	fO	f	o
85 - 96		Of		oF	f	o
97 - 108	repeated picture	Dd	repeated picture	dD	d	d
109 - 120		Ee		eE	e	e
121 - 132		Ss		sS	s	s
133 - 144		Pp		pP	p	p
145 - 156		Oo		oO	o	o
157 - 168		Ff		fF	f	f

Table 1. The symbols *S, E, P, F, O, D*, refer to the picture types, of spider, everyday item, plant, flower, and dysphoric described earlier. A second use of the letter *D* relates to the probe condition labels used on figures appearing later in the text.

For the first probe , there were 4 probe conditions:-

1) THREAT - where a spider picture was probed, while with one each of the spider-like plant, dysphoric, and everyday items were also presented.

2) INTERFERENCE when neutral pictures were probed, and spiders were used either as fillers, or probed by the second border, then the spider picture acted as an interference to the first border location response. Subjects could not know if the spider stimulus would be probed, so the two first probe responses were grouped together.

3) NO-THREAT When no spiders, (or spider-like plants) were presented, only neutral affective valenced stimuli (flowers, and objects) were shown, and probed.

4) REPEATED PICTURE this acted as an analogue of MacLeod et al's (1991) Single string task. The same picture was repeated on the card, in the 4 corners, and was probed twice. These cards varied in affective valence, as described by the categories from which they were made.

For the second probe the interference probe conditions consisted only of the remaining cards featuring spiders as filler stimuli. The other difference from first border , was the addition of a fifth probe condition labelled as "Dwell". This involved responding to a neutral stimulus card type, after the first picture probes was a spider.

Selection of the border locations

The primary task was to report the location of a border. Handedness, and a stimulus reading effect (where the upper, or the left-most stimuli in a multiple stimulus display, could possibly be processed first) are the two artifacts that need to be controlled. Four response keys were used. By measuring responses on each key for the first border [1], followed by responses on each of the three remaining keys for the second border [2], means that two useful features are apparent. Firstly all border-pair position combinations will be encountered within 12 trials; and secondly, three responses will occur on each key. Averaging should then remove any differences in responding due to hand, finger, border position or presentation sequence influences.

The sets of border appearances (shown in Figure 2) are constant, and were used on each group of cards.

Where an error occurred, because the response was to an incorrect key or did not occur within the selected time frame, the card was later re-used and selected at random from the other un-used cards.

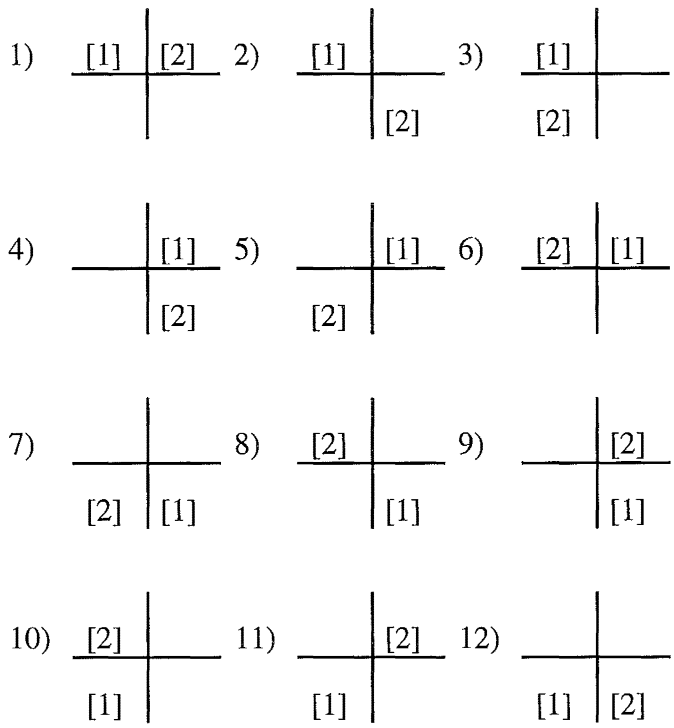

Figure 2. The set of 12 positions that the pair of borders will occupy on the card layout.

Filler pictures - Distracting (irrelevant) stimuli

To keep the number of stimuli to a minimum, one picture was used for each (first, and second) border position. These appeared in each one of the 12 above mentioned first, or second border positions. For example in the group of cards where the threat is the first stimulus probed, followed by an everyday item , a different spider appeared in each of the 12 first border positions. In the second border positions, a different everyday item appeared in each second border location. The other two positions on the card were spider-like plants, and dysphoric pictures, again each one different for each card. Allocation of pictures to these filler positions was random, but each type of stimulus occurred equally often. This card design gives the minimum number of picture combinations. To use each picture, paired with every other stimulus, and with each combination of filler stimuli, would have resulted in thousands of cards.

Among the different spider inclusive cards (numbers 1 - 72) each of the spider, plant, dysphoric, and everyday item pictures were seen six times, and twice probed by the first border . Each picture was seen once per line, in the first six lines of table one.

In the repeated picture condition, each picture (including those from the flower, and object categories) was seen one further time. The spider, plant, dysphoric, and everyday item stimulus pictures were therefore seen, and probed an equal number of times.

The no-threat cards (numbers 73 - 96) were made from of fewer pictures, but were seen as often as the spider inclusive cards. The no-threat category pictures were probed once in each of the first eight positions, and then the first four were repeated, and re-probed. On the second probe conditions, the remaining four pictures were repeated, and re-probed. No-threat stimuli were shown in pairs on a card. The individual pictures were probed half as many times as those used in the spider inclusive probe conditions. This can be seen in table 1, where each of the flower-to-object and object-to-flower probe conditions only occur once (and, on one line of table 1).

The pictures were not matched for contrast - some predominantly black pictures occurred on the same card as lighter unfilled line drawings. The averaging of 12 first or second reaction times , and the constant use of the same stimuli for all subjects should have controlled for possible influences in stimulus brightness.

Recognition test

Sixty four new pictures were drawn, to use in conjunction with the test stimuli, for a two stimulus forced-choice memory test. The recognition pictures were similar to the pictures used in the experiment.

One of each of the recognition , and experimental pictures was displayed on this new type of card. The pictures appeared on either the left or the right side of the screen. These positions were randomly selected. The test itself cycled through the test cards in a common presentation sequence ;- spider, plant, dysphoric, objects, and the no-threat card pictures. Subjects responded verbally saying left or right to indicate which picture they had seen in the experiment. The experimenter then wrote the choices on a score sheet. Subjects pressed a response key to proceed through each card in the set at their own pace.

Apparatus

An apple Macintosh SE computer, with a Macintosh M1050X monochromatic 12 inch screen, used Hypercard software to present all experimental stimuli. Subjects indicate border position by depressing keys on the computer keyboard that closely represented the layout of the borders on the screen. The keys "A" and "Z" were used for borders occurring in the upper and lower left regions of the screen respectively, and the keys "K" and "M" for borders on the right side. To prevent finger misplacement, "Blutack" covered the centre of the key tops. (A keyboard "guard" that covered all but the response keys, was considered , but this interfered with key travel, and made responding more difficult.) "Blutack" was found the most effective way to ensure subjects knew they had correct finger placement, and was sufficient to ensure this.

All timing was in 16.667 ms "ticks", which is the cycle time of the Hypercard software.

The "Y" character key was introduced so that subjects could stop the experiment, if they wished.

The experiment was conducted in a small auditory laboratory. A small desk supported the computer. Subjects could rest their wrists either on the desk top, or on a partly open drawer. Resting the wrists was necessary, because subjects held the first two fingers of each hand poised above the four response keys. The index fingers were on the blutack covering keys Z, and M, and the second fingers were lightly on A, and K. The other two fingers, and the thumb could be used to support the hand, by resting on the front edge of the keyboard surround frame.

Subjects sat approximately 40 cm from the screen. This meant that the diagonal measurement across the corners of the pictures (172 mm) resulted in the cards subtending a visual angle of 24° 16''. The individual picture stimuli subtended 5° 43". Border measurements increased this angular size to a card angle of 24° 57", and border angles of 6° 26".

Procedure

Each trial began with a fixation cross appearing for 500 ms in the centre of the screen, on the central axis that the four stimuli were laid out upon. This cross turned off briefly leaving the screen blank for 500 ms.
A card was randomly selected from a holding pool. This card remained on the screen, and five hundred milliseconds after the card appeared, a square border was drawn around one of the pictures on the card. The border stayed on screen until either a response was recorded, or a randomly selected time interval had passed. This time varied at random between 750 and 1500 ms.

Once a response was made, or the chosen time had elapsed the border "moved" and was instantly re-drawn around a second picture, (again previously decided upon by the card design). A second randomly selected presentation duration was produced, within which a response had to be made. Once a response or time-out had been recorded, the screen went blank, and the process of displaying a fixation cross, and a card was repeated. For the card to be scored as correct, responses to both borders had to be on the correct keys, and within the selected time frames. When these conditions were met the card was removed from the holding file. Cards not responded to correctly remained in the file to be chosen at random later. This process repeated until all of the cards were correctly responded to.

Subjects were shown into the Auditory laboratory, and seated by the computer. They were first given a consent form to complete, and then an instruction sheet to read. (See appendix 1)

The instructions explained which keys to press when the square border appeared, and that after a response a second border would appear and also have to be responded to. The experimenter also verbally reminded subjects of two things. Firstly that the fixation cross was there to ensure that their eyes settled and remained in the middle of the screen, and secondly that if for any reason they did not wish to continue the experiment, they could press the "Y" key to stop the experiment.

Subjects then completed a set of 10 practice trials, made of neutral pictures not used in the experiment.

The experimenter remained outside the room during the experiment, which lasted approximately 10 minutes .

Following the experiment subjects completed the spider phobia questionnaire. The questionnaire was given after completion of the experiment so that the recall of any experiences or issues addressed in the questionnaire would not interfere with the "mood", or current state anxiety of the subjects.

The questionnaire took approximately 5 minutes to complete.

After completing the questionnaire, subjects were given the recognition test, designed to assess their memory of the stimulus pictures.

Results and Discussion

Over all card presentations, error rates due to responses to incorrect keys were only 4.5 % for the phobics , and 4.1 % for the controls. The cards involved two responses, therefore the response error rate can be considered as approximately 2% for both subject groups. This compares with the error rate of approximately 6 % described by Mathews et al (1991) in the dot probe task. Excessively long response time errors on cards, were extremely low, - the phobics only making 1.5 % of these kind of errors, and the controls 0.8%.

For each subject, the 12 reaction times for each picture category, were averaged to give 26 probe condition means. As can be seen in the first second and fourth columns in Table

1, each of the multiple picture card probe conditions have two means for the three first border and four second border, probe conditions . Also there are 6 first, and 6 second border means from the repeated picture cards. These means became the raw data for subsequent statistical analyses.

When analysing responses, the first and second border data were considered separately. Although the stimuli occurred on the same card, the probability of where the border would occur differs for first and second borders.

Repeated picture cards

For each subject, reaction times for each of the six types of repeated stimulus cards (displayed in the bottom six rows of table 1), were averaged to give six first-, and six second-border response times. These subject means are then averaged to give the six group means shown in Figure 2.

There appears to be no consistent, or sufficiently large difference between the groups, or between picture categories for either border occurrences. There is no suggestion in the data that the phobics are responding faster when borders occur around a spider picture. These flat data trends were confirmed by the results of a 2 groups x picture type (within subject) ANOVA. No first or second border effects reached significance.

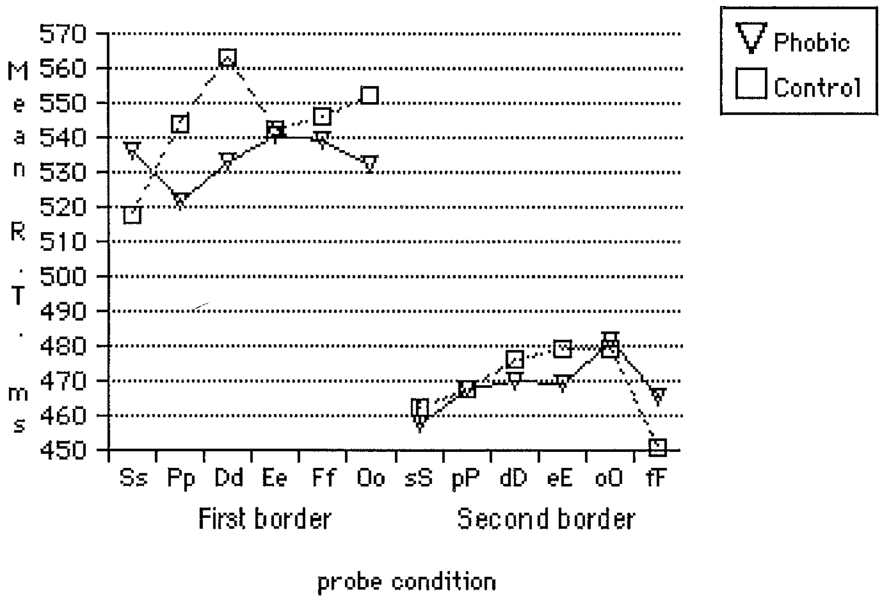

Figure 2. Experiment 1. Mean group response times as a function of picture type, for the repeated picture cards.

The results of both border detection phases, support the hypothesis that phobics show no differential response trends on trials where allocation of attentional priority is not needed. The present display is more complex than that used originally by MacLeod, and Mathews (1991) and still confirms their predictions.

The repeated picture cards also allow an analysis of the visual discriminability of the combination of borders and distracter pictures. There were no statistical differences between response times in the presence of different repeated pictures. The borders can therefore be considered as equally visible, in the presence of various picture categories. It can therefore be implied that the distracter picture categories are matched for discriminability.

Multiple valenced cards.

First border

The group mean response times to locate the border in the presence of multiple valenced cards are presented in Figure 3. The response data for each probe condition/picture category, are presented as a function of both card-sets. (Standard deviations ranged between 83 and 115 ms, and did not vary systematically with any picture category or probe condition).

Examining figure 3, it is apparent that the response times of control subjects are similar in each of the three probe conditions on each card-set. Their responses to the border are not affected by the presence of a spider, acting as a either threat, or an interference. In contrast the phobic group responded noticeably faster in the threat condition, but response times on interference, and no-threat probe condition trials were comparable to those of controls. For both groups, interference, and no-threat probe condition response times are similar, for both card sets.

Statistical validation of these trends was obtained by a groups x card set x probe condition ANOVA.

No effect involving card-set was significant. The probe condition effect was significantly different, F (2,38) = 14.584, $p < 0.001$. Importantly in the present context, a significant group x probe condition interaction effect occurred F (2,38) = 13.120, $p < 0.001$. Tests of simple main effects of probe condition conducted separately for each group, confirmed that the response times of the phobic subjects were not affected by threat or interference stimuli F (2,38) = 0.35, $p > 0.71$. Also from this analysis, the probe condition effect was significant for phobic subjects F (2,38) = 14.16, $p < 0.001$.

The application of Dunnett's test for comparisons involving a central mean (Kirk, 1968, pp 94-95) indicate the threat response times to be faster from no threat times, $p<0.01$ one-tailed. The difference in times between interference and no-threat probes was not significant.

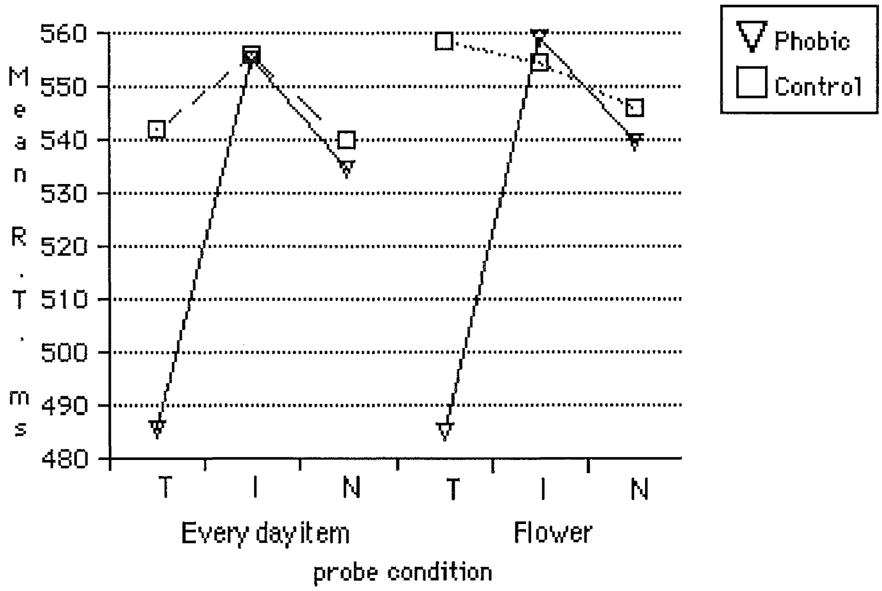

Figure 3. Experiment 1. Group mean reaction times , in milliseconds to locate the first border, as a function of probe condition, for each of the two picture-sets.

Mean reaction time data support the hypothesis that spider phobic subjects selectively attend to the spider stimuli, which results in altered performance on the border location task. The data presented in figure 3 show that the phobic, and control groups are responding the same to all stimuli except the probed spiders, and all card types. The lack of statistical difference between response times to no-threat and interference stimuli, when a spider is present is taken as evidence that the presence of a spider stimulus in itself does not produce altered responses, due to influences by secondary reactive processes or a global cognitive/perceptual avoidance. Within the small time period that picture stimuli are displayed before a border appears, all subjects must be obtaining similar information from cards. The phobics respond differently to the controls only when a threat stimulus is probed. The reason for this may in fact result from the prioritization of attentional resources to the threat stimuli. If the emotion of anxiety is a separate processing structure, or subsystem, as proposed by Oatley, and Johnston-Laird (1986), then it may only be utilised in goal related strategic processing situations. The presence of a threat outside of the region where the border locations are performed, does not in itself make subjects shift into a anxious processing mode. If it had, a group main effect should have appeared, where threat inclusive cards were processed, and responded to faster than no-threat cards by the phobic group. The observed distinct difference in response time only occurs to probed threat stimuli , and not to neutral pictures on cards featuring spiders in the filler positions. This unfortunately does not provide conclusive evidence enabling the exclusion of an arousal based explanation of selective attention

to threat stimuli. It can be suggested that processing biases are not occurring, on first border responses, because the interference probe condition is not statistically different to the no-threat condition. This implies that the spiders are not being "seen" more easily. A goal or strategy on the part of the phobics appears to incorporate threatening stimuli recei\ biased attentional allocation, only when they coincide with the reporting of a border's location.

An alternative explanation of the first border data is that the four stimuli are detected, and recognised by subjects within the 500 ms pre-border period, and for the phobics only the probed spider stimuli result in a response output difference, of a faster key press. The methodological problem with MacLeod et al's (1986, 1991) dot-probe task design is its bias towards assessing the influences of subjects selection of relevant stimuli. Both stimuli presented on trials are capable of being attended to at once, and a search of the array could result in subjects stopping the scan when they find a stimulus that is relevant to them. Because the probe occurs in a temporal separation from the distracters, an "interference" element does not fully exist, and the task is then biased towards a dwell effect. This explains why MacLeod et al (1986, 1991) conclude that their task implicated the allocation of processing resources and/or attentional priorities. Selective attention to threat stimuli, as expressed by ;the present experiment can be better described as the allocation of response priorities.

Second border

Table 1 also details the probe conditions for the second border. There is an additional condition - Dwell, being the response to a everyday item, or plant picture after a spider had previously been highlighted by the first border.

Group mean response times to second probes are displayed in figure 4, separately for card sets where everyday item, and plants were probed. Standard deviations ranged form 71 to 107 ms.

The expected second border data trends were that phobics would responded faster to borders appearing in the position of a spider picture. Additionally , responses to neutrally valenced pictures would be slower in the dwell condition, showing that attention cannot be easily disengaged from an initially probed spider picture.

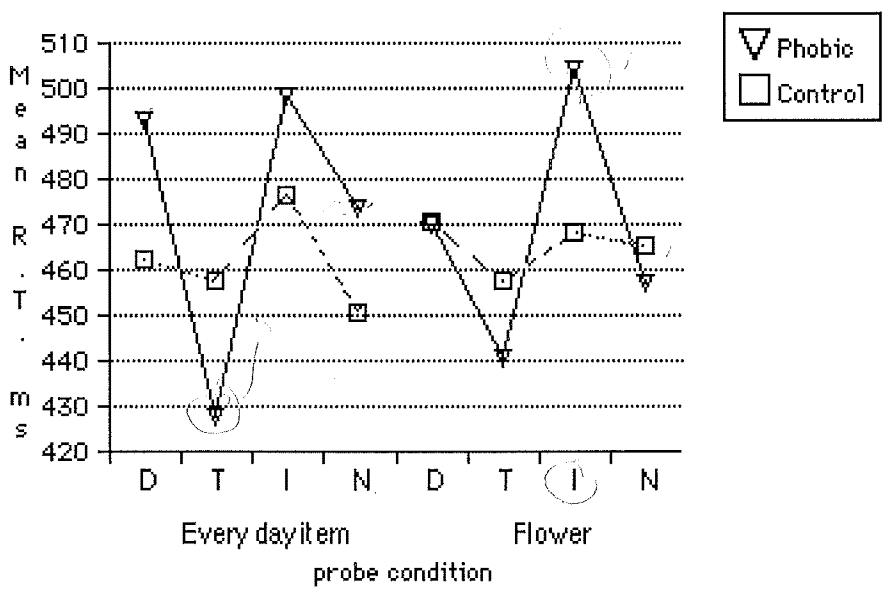

Figure 4. Mean group response times to the second border as a function of probe condition for both picture sets.

To analyse the second border response times, the data were initially treated by a groups x picture set x probe condition ANOVA. Since the group x card x probe condition interaction was significant *F* (3,57) = 2.983, p < 0.05, separate groups x probe condition ANOVA's were performed on each card set.

For the Everyday item picture set, results were as follows. The group and probe condition interaction was significant F (3,57) = 4.80, $p < 0.05$. The effects of probe condition were then tested for each group separately. Control subjects exhibited no difference between probe conditions, F (3,57) = 1.39, $p > 0.25$. Phobic subjects differences between probe conditions were statistically reliable, F (3,57) = 13.30, $p < 0.01$.

Dunnett's test for caparisons involving a central condition (no-threat) was applied. Threat responses were faster than no-threat times, $p < .001$ one-tail. Neither the Dwell or Interference mean times differed from the No-threat time.

The Plant card set were treated in a similar way. Firstly a groups x probe condition ANOVA was performed. The groups x probe condition effect was statistically reliable (3,57) = 2.98, $p < 0.04$. Probe condition effects were then explored for each group separately. Response times in the various probe conditions did not differ for control subjects, F (3,57) = .32, $p > 0.80$. However, phobic response times were affected by probe condition, F (3,57) = 8.29, $p < 0.001$.

The Dunnett's test revealed that the response times in the Interference condition, exceeded those of the No-threat condition, $p < 0.01$ one tail. No other differences were reliable.

Second border discussion

The main finding of the secong border data was that while the presence of a spider had no effect on the location times of control subjects, it did for phobics. As with the first probe, borders surrounding spider pictures were reported more quickly than borders surrounding neutral pictures. Thus a speeding to the threat stimulus was evidenced.

Unlike the first probe, border location respopnses were slower in the interference condition, and also in the dwell condition - at least for the plant picture set. That is, borders surrounding a neutral picture tended to be reported more slowly when the card also contained a spider. It appears this interfering effect of the spider was not greater in the dwell condition when the spider had been the subject of a previous probe. That is, the results provide no support for a dwell effect over and above the general interference effects that a spider may have on phobic subjects. The lack of a dwell effect is consistent with Fox (1993) who reports that phobics do not appear to dwell on threat stimuli.

Conceptually, dwell is the opposite of the arousal explanation which predicts fast "escape behaviour". There is no suggestion that neutral probed items were reported faster, when they were preceeded by a spider probe. The first and second borders differ in the probabilities of where probes will occur. The initially probed picture is seen for only 500 ms, while the second can be allocated attention from the onset of the card (500 ms) throughout the time taken for a response, until the second probe occurs (approximately another 500 ms). By the time the second border response is initiated, subjects could know various things about the next possible border location. In the case of no-threat cards, might know that there are only flower and object pictures present. When a plant, or an everyday item is a first border prob, the position of the spider for a second probe is more apparent. Finally, for several reasons the dwell probe condition was a crucial data measurement, and it provided interesting data in support of an interference effect, compared to fear induced speeded responding after a threat had been experienced. If a spider has previously been responded to for the first border, subjects will know that they can let their attention relax, and no further threatening stimuli will be probed. Therefore, the dwell condition may be considered a "threat no longer exists" condition, and as such might be regarded as a variant of the no-threat condition. However, the response times obtained in the dwell probe conditions were generally slower than no-threat probe condition responses, so this explination is unlikely. If the "Dwell" condition is not measuring a dwell response, then it is best considered a test of the influence of state arousal on response output.

The different Interference probe-condition results obtained for first and second borders does not conform to any single model. The theoretical underpinnings of attentional prioritization proposed by Williams et al (1988) refers to Schneider and Shiffrin's automatic and strategic processing stages. When such principles are applied to the present tasks data, inconsistencies arise. Firstly, that the least amount of time to view trial stimuli occurs with first border location times. The most likely process operating would then be an automatic one, but if this was so an interference effect should result. This did not occur, and led the opinion to be expressed that a stragegy appears to be involvedwhere phobics respond to spider stimuli exclusively, during border location responses. The use of a strategic process for the second probe location is acceptable, given that stimuli are viewable for twice the time prior to a second border location response.

The predicted effects the border location task produced were significant, although possible design weaknesses are apparent.

A possible confounding factor in this experiment is the mismatch between stimulus discriminability, when a complete card is considered. The fact that the spiders are a more homogeneous category (more easily categorisable) may result in increasing the discriminability of spiders when they appear in the context of the less homogeneous dysphoric, and every-day stimulus categories. This explination is unlikely, as the controls do not show any pattern of increased vivibility of the spider category.
However, if the plants are a homogeneous set , and they appear similar to the spiders, they may have resulted in the large interference effect. The issue needs to be resolved by improving the homogenity of stimuli within categories, and the separation of spider-like plant stimuli from spider inclusive trials. The spider-like plants would have to be probed, and analysed in the same way as threat stimuli.

Recognition test.

The results of the recognition test are displayed in Table 5, and are expressed as percentages correct. Phobics appear to recognise more everyday item and object pictures, while the control subjects recognise fewer spiders. The percentage of correctly recognised stimuli for each group were compared, using a two way ANOVA. The observed trends were not statistically reliable.

Table 5. Mean number of pictures correctly recognised as a function of group and picture category.

	Picture category types

Group	S	P	D	E	F	O
Phobic	0.65	0.59	0.58	0.81	0.60	0.77
Control	0.54	0.74	0.77	0.81	0.69	0.72

The lack of differences in recognition conforms to the theories of Watts et al (1986; 1988), and Ehlers (1988), which predict no difference in memory for threat material for phobics. This is in opposition to Bower's mood congruent memory bias, which would expect that because the stimuli are relevant to the phobics, they would be remembered better than non-threatening stimuli.

The model proposed by Williams, Watts, MacLeod, and Mathews (1988) states that for anxious subjects attentional allocation occurs towards threat stimuli, and away from neutral or non mood-congruent stimuli. Controls however shift attention away from the threat. This appears to be a misguided premise to base their model on, which rests on the twisting of the description of control subjects response trends. As noted earlier, with no baseline condition in the dot-probe experiment, statements of the relative speeding or slowing of responses cannot be made. Therefore the control subjects response trend could equally be described as a moving towards the neutral stimulus - a further manifestation of effects due to mood congruence and/or stimulus relevance. An analysis of stimulus relevance will b conducted in the second experiment.

EXPERIMENT 2

Introduction

Experiment 2 was intended essentially as a replication of experiment 1 with some design improvements, the use of a similar version using word stimuli, and the use of a group of spider "experts". One difference between phobic and control subjects in experiment one, and previous published research, is that while the spiders are particularly salient for phobics, there is nothing in the displays of interest/relevance for the controls. However, spiders would surely be relevant and significant for people who make them their domain of academic research. By using spider experts on the border location task it is possible to assess the effects of relevance, independent of threat, on attentional allocation. The e: could be considered as additional controls, because they have no fear of spiders, or as a group expected to respond in a similar way to phobics because the spider stimuli are relevant for them.

In addition to the threat, dwell, interference, and no-threat probe conditions of Experiment 1, the present experiment employed a peripheral condition. These cards contained four no threat pictures, which occupied the usual positions, and a spider, or flower picture or word outside the area of the others. These peripheral stimuli were never probed. The basis for this task was to create a situation where the distracting stimuli were spatially separate from the relevant task of locating the borders. This makes a task that is more complex than the Stroop based tasks, and provides a strict test of the distracting power of threat/relevant stimuli. Fox (1993) tested anxious subjects on a similar task, but trials did not involve individual stimulus presentations, or stimuli resulting in a visual angle as large as the present stimuli.

The experimental design improvements for the border location task were as follows. The dysphoric pictures were replaced by more neutrally valent pictures of people (a category referred to as Human). In Experiment 1 dysphoric pictures were never probed. Consequently, if subjects in Experiment 1 were cognisant of the picture categories on each card they could have realised that the first probe must occur in one of three locations, and the second probe in one of two. Replacing the dysphoric pictures with a more neutral category which was probed, increased the uncertainty of probe location - all positions could now be the subject of a first probe, and the remaining three were available for the second probe.

A further adjustment related to three concerns about the stimuli used for no-threat cards. Firstly the stimuli making up these cards were not seen in the presence of a threat. Second, the Flowers and Objects were different to the other neutral stimuli of Everyday items, and Plants. Finally, the no-threat pictures were presented in pairs. This was a completely different format to other cards, which featured four different pictures. No-threat cards need to be constructed from stimuli that had occurred in all types of experimental trial- (threat, interference, plant- interference, and no-threat trials).

It was considered appropriate to isolate the spider and plant stimuli so that the spiders, and plants that look like spiders are no longer on the same card. This will allow a comparison of whether the plants may be perceived incorrectly as spiders and induce similar effects to those caused by the spider pictures. Also it ensures that any confusion resulting two visually similar stimuli is controlled for. The separation of the threat stimuli and their controls will then establish whether any influence of distracter stimuli is based on perceptual or semantic (meaning) factors. If subjects state that plant stimuli appear similar to spiders, but their response measures show that they are not affected by them, perhaps the processing of stimuli at the meaning level "overpowers" later conscious evaluations. The important question then becomes "Is the effect at the visual level alone?"

An attempt to study this, involved using practice trials that presented four types of abstract stimuli that looked progressively similar to a spider. This looked for the possibility of some differences in responding between the subject groups, that could be based on the presence of an abstract stimulus hopefully considered as devoid of meaning. The symbol could then lend support to the idea that there is a low level perceptual bias amongst spider phobics, that favours this eight armed image. The fact that it gave practice on the experimental task was the main issue, therefore the task was short, and not perfectly balanced in the type of symbol probe conditions.

Due to the increased number of stimulus categories, and the resulting increase in combinations of target moves needed, the experiment became over twice as long as Experiment 1. A small number of subjects in experiment 1 mentioned that their eyes began to tire near the end of the task. A crucial design parameter was that the present task could last no longer than 20 minutes. The current tasks included a 20 second rest period, every three minutes. Subjects could also initiate rests by pressing the "space-bar" key on the computer keyboard, as they felt it necessary.

To keep the total number of trials each subject completed to a comfortable number, it was necessary to divide the pool of stimulus cards into smaller parts. Each smaller pool comprised a random selection of half of the stimulus cards. Each half of the experime took approximately 17 minutes to complete.

Hypotheses

The central hypotheses of this current experiment were -

1) The pattern of results for the picture experiments should replicate Experiment 1, where phobics respond faster to borders that appear around a spider picture. If the effect of selective attention is due to the relevance of the picture to the subject, and the spiders are considered relevant to the experts, then experts should respond in a similar fashion to the phobics. No published research to date has tested two different groups with the same stimuli in this way. Effectively the design of previous research has been biased to present the control subjects with a task involving stimuli that have no particular relevance for them. For anxious groups, however, the stimuli are relevant, and can have personal meaning ascribed to them. The present study considers the spider stimuli not as a threat, but as stimuli that are relevant for both the phobics, and experts.

2) There will be no speeding of responses to probes around pictures of spider-like plants.. The selective attention effect is expected to result from the meaning ascribed to stimuli, not to their perceptual similarity alone

The basis of this set of tasks is the testing of the hypothesis that stimulus relevance is the mediator of selective attention.

Method

Subjects

The nine "experts" used for this experiment were three women -mean age of 28.29 years , and six men - mean age of 22.67 years. Most of these subjects were zoology graduate students who had either completed or were currently involved in research on spiders. research consisted of a thesis, or laboratory work that involved contact with, or the handling of spiders. The subjects were three doctoral students , three first year Zoology Bachelor of Science honours students, two museum technicians (entomologists), and one undergraduate who had completed laboratories on spiders. All of these subjects were confident handling spiders.

The Klorman et al (1974) "Spider questionnaire" scores were obtained from only eight of the subjects, giving a mean value of 1.13. This value is extremely low, given that the questionnaire consists of 31 items. Similarly, Dimensions of spider phobia questionnaire (Watts et al, 1986) scores were obtained, giving a mean of 9.67 which is well below the cut-off of 14 for phobia classification. The Spider Questionnaire (Klorman et al 1974) had to be used in addition to the Questionnaire of dimensions of spider phobia (Watts et al 1986), to resolve ambiguity in rating the experts. Watts et al's questionnaire was biased to detect phobic responses, and if the term *spider* was replaced with *your research (that relates to spiders)* , expert subjects responded yes to questionnaire items, and this increase in affirmative answers resulted in their classification as phobic. Because of this all subjects received both scales to complete.

Six women, and one man arachnaphobics, had a mean age of 25.38 years, and scored on the Spider questionnaire a mean of. 21.29 and for the Dimensions of spider phobia questionnaire 22.17. Both scores classify subjects as phobic.

Subjects were not matched for gender, but were matched approximately for education level, and age. No control subjects were tested, because the experts had to be found and tested first. When data analyses of the phobics responses to the border task displayed no trends, it was considered unnecessary to test controls. The redesigned experiment was considered unsuccessful at the time.

Apparatus

The experimental setting remained the same, but a new computer was available. A Macintosh LC II , with a larger Philips 9CM080 15 inch colour monitor was used. Viewing distance was increased so that visual angles were similar to (but possibly sli larger) than was used in Experiment 1.

Procedure

As in experiment 1, subjects were shown to the seat and desk, made comfortable, and given the consent and instruction sheets. The rest initiating key was explained, and subjects reminded to use it if needed .

A more complex practice task was given, that lasted for 3 minutes. During this and all experimental sessions, the experimenter remained outside the testing room, and was called in to start the different tasks.

After completing the practice experiment, subjects participated in the picture task , followed by the word experiment, and a peripheral task.

The picture and word experiments were based on the same separation of cards into two parts. Therefore subjects had to be tested on the different two parts to prevent the possibility of their guessing border movement sequences. Subjects 1, 3, 5, 7, 9 were given the first half of the picture task, the second half of the word task, and the peripheral picture task. Subjects 2, 4, 6, 8, and 10 were tested on the remaining parts of the picture and word tasks, and the peripheral word task.

Before beginning the word and peripheral tasks, the phobia rating questionnaires were completed. This was another form of rest from looking at the screen. A new key introduced to this experiment was the "Space bar" , which enabled subjects to initiate a 20 second rest period. This ensured that subjects did not suffer from tired eyes, or any "fuzzy" patches in their vision. The occurrence of these after image effects implies that at least some subjects were maintaining a centrally placed eye position. This justifies the fact that eye movements were not monitored in Experiment 1, or the following experiments.

For rest periods subjects were told to shift their focus to the wall, or ceiling. After 20 seconds of time out for a rest a warning beep occurred, which meant that subjects had two seconds in which to return their gaze to the screen.

The final task that the subjects participated in was the peripheral distracter experiment . This was either the word, or picture version. Decisions on which subject participation on either task was described above.

Practice task

Stimuli

Two classes of stimuli were derived from a cross (X). Neutral stimuli consisted of an asterisk (5 pointed), a cross, and a cross with a horizontal line through the centre. Stimuli designated as Threat were formed by the superimposition of two crosses (double cro give a spider-like eight-armed symbol. Cards were formed from these stimuli to give Threat, Interference, and No-threat probe conditions. Probing a double cross gave the Threat condition. Interference probes occurred when the border appeared around a Neutral symbol on a card containing a double cross. On No-threat probes the border appeared around a Neutral symbol, on a card containing no double cross symbol.

Only the spider symbol was probed in all 12 first and second probe conditions positions (as in table **1**). The non-threatening symbols were randomly selected to have a border appear around them one third of the time. This constraint was necessary to keep the practice task within limits. Threat, Interference, and No-threat probe conditions were run.

Results

Response times were averaged across trials to give a Threat, an Interference, and a No-threat time for the first and second border location responses, for each of the nine experts, and seven phobic subjects. Group mean response times for both first and second probe conditions are given in Figure 5.

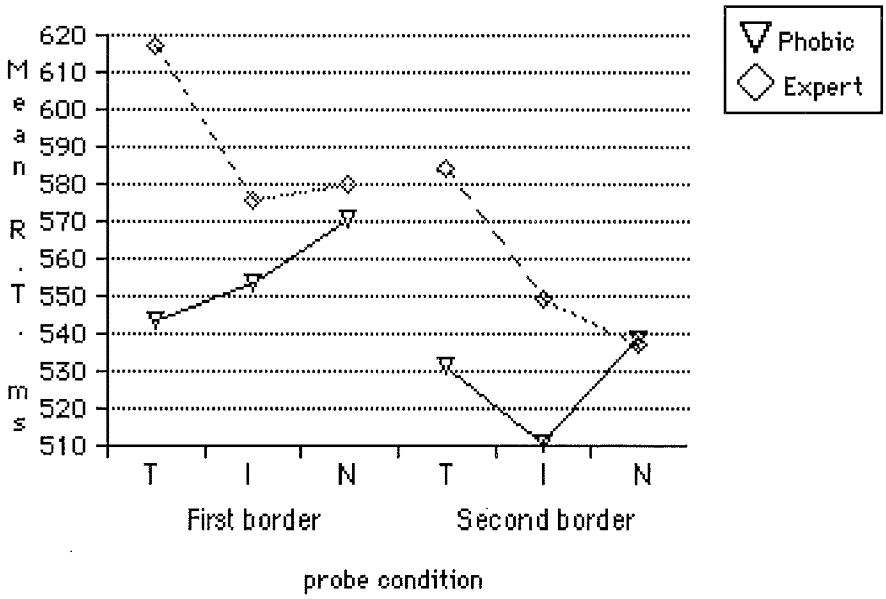

Figure 5. Border location response times as a function of group, and probe condition.

In the analysis of the first probe data, only the groups x probe condition effect was reliable, F (2,25) = 3.5, p <0.05. Examination of Figure 5 reveals that while Experts responded more slowly to a border around a spider-like eight-armed symbol than to borders around neutral stimuli, the reverse was true of the phobics.

Trends were less apparent in the second probe data. Figure 5 indicates that again experts were slower to report a border when it appeared around the eight armed symbol, but unlike first probes, probe condition did not appear to affect phobic subjects. In this analysis the groups x probe condition approached significance, F (2,24) = 3.02, p <0.10. The probe condition main effect was also of borderline significance, F (2,24) = 3.07, p <0.10.

While trends are not strong, overall the results suggest an unexpected slowing of border location responses involving spider-like stimuli on the part of the experts. The spider like symbol does not create a distraction in the interference conditions. The spider symbol has an increased number of response measurements, which should cause the resulting mean to regress to a more conservative value. The spider symbol was measured 66% more often, yet still appear different to the neutral, and interference probe conditions. No valuable explanation can be offered for this effect.

Picture stimuli.

The experimental design for this task was similar to Experiment 1. The differences were the removal of plant pictures from spider inclusive cards, and neutral stimuli were better defined and categorised. The four neutral stimuli had increased numbers of flower and object stimuli, which enabled each of the 12 stimuli per category to appear with all of the other 12 stimuli from other categories. This meant that the 5 stimulus categories (spider, people, objects, spider-like plant and flower) were presented equally often, and were all probed by a border.

An additional analysis was possible, where the influence of the spider like plant stimuli on the border location task could be compared to the influences spiders had, with plant threat, and plant interference conditions analogous to those of spider threat, and spider interference. Plant stimuli were presented on cards that were similar to the spider ones, but with plant stimuli replacing the spiders.

Stimuli

Spiders (S) The spider category "S" used in the Experiment 1, was re-used for this experiment.

Humans (H) The dysphoric category was redesigned to that of a common theme of people. This gave a more homogenous, and affectively neutral category of pictures. This new category was not tested for category compatibility by the judging team, because the pictures were obviously people.

Flowers (F) The Flower category was extended to have 12 flower pictures . These additional pictures were also selected from J, Mathews (1986).

Plants (P) The pictures of plants that looked like spiders used in Experiment one were re-presented for this experiment.

Objects (O) The everyday item category was refined so that pictures appearing to have rigid outlines (squares, rectangles, or triangles),or that were overly dark were replaced with new pictures

There were now three neutral picture sets - flower, object, and human. This meant that the neutral filler pictures used were randomly selected from three picture categories. First border probe conditions were similar to those used in Experiment 1 (Table 1) having spider-threat, spider-interference and no-threat probe conditions. There was also the inclusion of a plant-threat, and plant-interference condition for the first border. Second border probe conditions again matched those used in Experiment 1 with the addition of a plant-dv and plant-interference condition.

The Set of 420 of cards was divided at random into two sets, designated "A" and "B", of 210 cards each.

Repeated picture cards

Results

An error in the program operation involving the first expert subject, meant the particular subjects data had to be eliminated from the present Picture card set analyses. There fore the results mentioned here are comparisons between eight experts, and seven phobics.

A repeated picture condition was previously included in Experiment 1. This was included in Experiment 2, again to demonstrate that phobics respond differently to threat stimuli only in multiple-valenced situations, and now to establish how experts respond to salient information. Subject mean response times were found for each first and second border response for each of the Spider, Human, Flower, Plant and Object picture sets. Group means are presented in Figure 6.

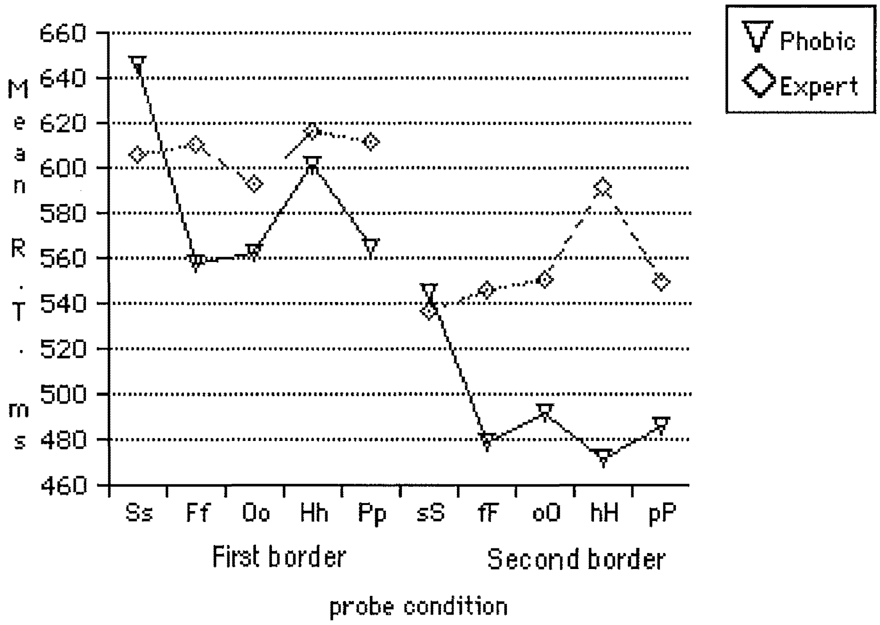

Figure 6. Experiment 2. Group first and second border location times as a function of group and picture set.

Standard deviations ranged from 90 -147 ms for first border, and 45 - 118 ms for the second border for the phobics, and for the experts first and second border ranges were 87 - 106, and 88 - 126 ms.

The first- and second- probe data were treated by separate groups x probe condition (within subject) analyses of variance. When degrees of freedom were adjusted to account for the fit of data to underlying assumptions, no reliable effects were found for either analysis.

Both border responses involving repeated picture cards provide converging evidence that phobics were not responding faster to cards displaying spider pictures. Experts also, show consistent response times, irrespective of picture valence.

Multiple valenced cards

The treatment of multiple valenced cards parallels that of Experiment 1. However, the present design enabled probes to spider-like plants to be treated as spider probes - with corresponding Threat, Interference, and Dwell conditions.

The overall error rates for probes on multiple-valenced cards was 5% for phobics, and 2.6% for experts. Standard deviations ranged from 99 to 123 ms, for the experts, and 103 to 130 ms for the phobic group, and did not vary systematically.

Spider Card set.

Mean group response latencies are displayed in Figure 7. Note that spider like pla appeared on none of the cards involved here. A groups x probe condition x card set ANOVA, indicated that there were no statistically reliable effects.

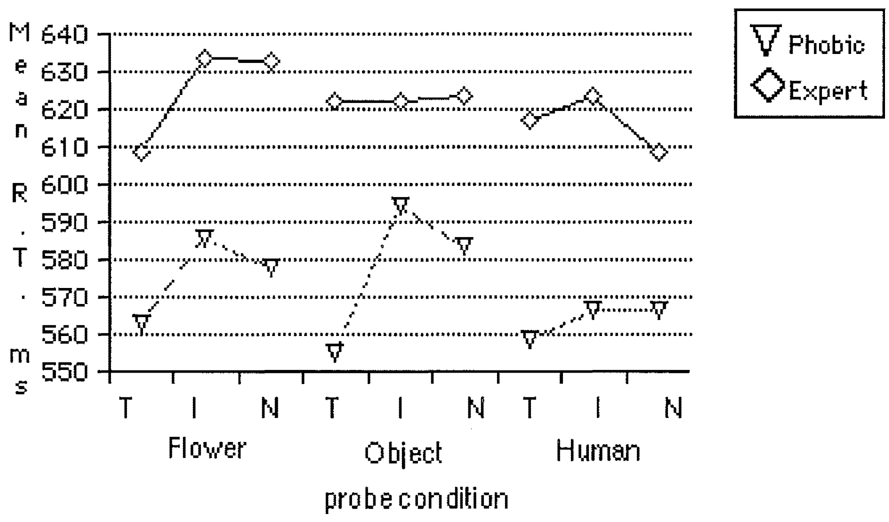

Figure 7. Group mean response times to report the first border on the Spider set of multiple valenced cards.

Second border

Group mean responses for the second probes to the spider sets of cards are displayed in Figure 8. Standard deviations ranged from 92 to 144 ms, for the experts, and 89 to 133 ms for the phobic group.

The data analysed consisted of the mean response times for nine experts, and seven phobics. The data were treated by a groups x picture-set x probe condition ANOVA. The only reliable effect was that of the interaction of probe condition and picture set, F (6,78) = 3.47, $p < 0.05$. Tests of probe condition, separately for each picture set revealed that there were no reliable probe condition effects for the Object, and Human picture sets. There was however, a significant probe condition effect for the Flowers, F (3,39) = 4.04, $p = 0.014$. As can be seen in Figure 8, border location times were greater in the Dwell and Interf

conditions for both experts and phobics.

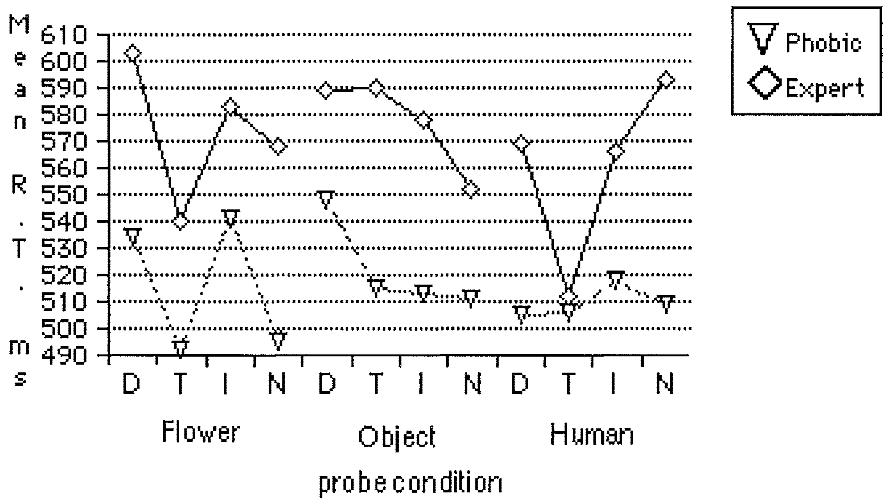

Figure 8. Group mean response times to report the location of the second border on the spider set of multiple valenced cards.

Discussion of first and second border, Spider card set.

The repeated picture cards, which are in effect a check of the discriminability of the combined border and distracter stimuli, display a tendency for phobics to respond slower to probed spider stimuli - although the effect was not statistically reliable. This results in the possible under-reporting of speeding to probed spiders, in the Threat probe condition, and an over reporting of Dwell and Interference conditions.

The predicted effects for phobics displaying Threat, Dwell, and Interference response trends similar to those obtained in Experiment 1, did not eventuate for either the picture or word card sets.

The only indication that the Spider stimuli had any effect on the border location task occurred for second probes and then only for one of the three picture sets. For the Flower picture set, the presence of a spider either as a previously probed stimulus, or simply as a filler appeared to slow border location responses of phobics, and experts alike. Experts similarly display a slight response slowing during the Interference probe condition.

Spider-like plant Card set.

The inclusion of a task that targets spider-like stimuli is intended to study whether the attention alterations shown by phobics is due to a low level perceptual bias. If the spider-like stimuli cause the familiar response time trends, then subjects may be displaying a pre-conscious influence. Secondly if no influence occurs, the attentional biases suggested may be due to either a intermediate processing stage, (possibly a meaning based analysis of the stimuli), or a response stage output. This latter possibility of response out-put influence is unlikely, given that phobics showed faster key presses to targeted spider stimuli in multiple valenced trials, but not Repeated picture trials Experiment 1. Therefore it can be said that they do not appear to be producing Escape or avoidance key-press responses.

The analysis, and presentation of these cards, is the same as used for the spider cards. The stimuli used for the neutral, and filler pictures on the spider cards are also used for the plant cards. The no-threat card stimulus values mentioned in graphs, and tables, are those also used for the spider set.

First border

Group mean first border location times are presented in Figure 9. Standard deviations for the various picture set probe conditions ranged from 99 - 133 ms for phobics, and 102 - 135 ms for experts. A groups x picture set x probe condition analysis of variance was performed. There were no significant effects, and nor did any approach significance. There is no suggestion that the spider-like plants in any way appeared like a threat or particularly salient, to either group.

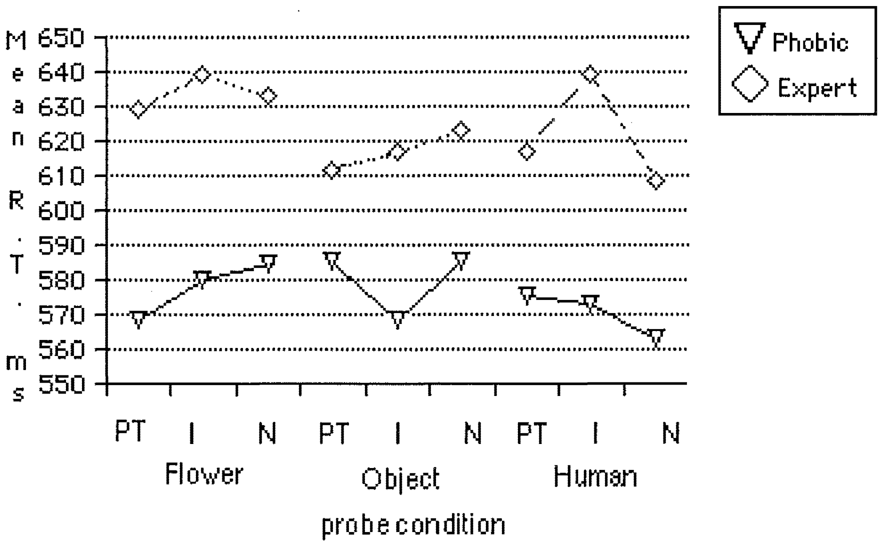

Figure 9. Group mean first border location times for spider-like plants.

Second border

Group mean response times are shown in Figure 10. Standard deviations for the various picture set probe conditions ranged from 69 - 100 ms for phobics, and 88 - 127 ms for experts. The data were treated by a groups x picture-set x probe condition ANOVA. This revealed significant effects of picture set F (2,24) = 10.06, $p < 0.01$, and probe condition F (3,36) = 7.672, $p < 0.01$. The picture set x probe condition interaction effect was also significant, F (6,72) = 3.35, $p < 0.025$. No interactions involving groups were significant.

Tests of probe condition effects were performed separately for each picture set. Border location times varied as a function of probe condition for the Flower picture set only, *F* (3,36) = 12.925, p < 0.001. Examination of Figure 10 suggests border location times were much slower when spider-like plants were absent from a card.

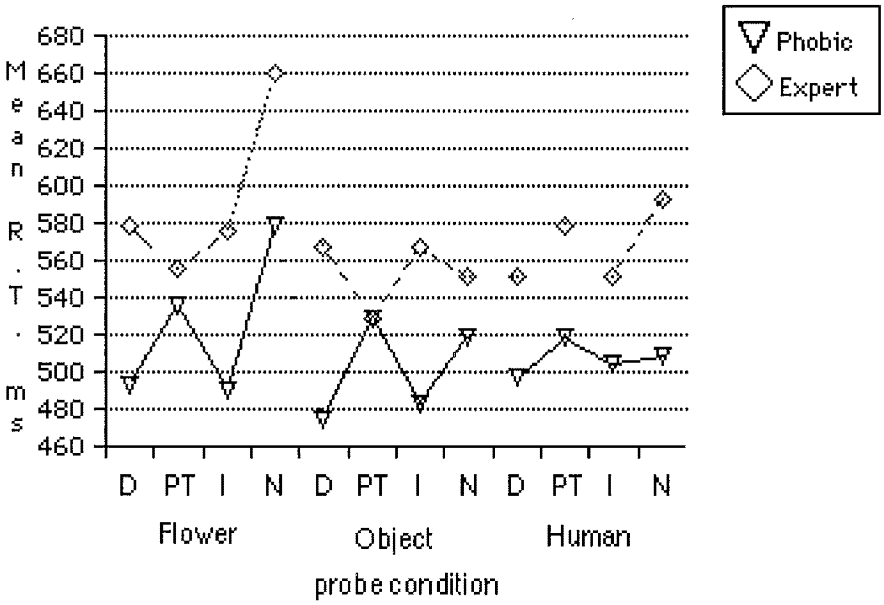

Figure 10. Experiment 2. Group mean response times to report the location of the second border on the plant set of multiple valenced cards.

Apart from the first card set it would appear that subjects are not confusing the spider-like plants with spider pictures. The separation of these stimuli to make them appear on different cards, was in order to show that the subjects were not responding to stimuli on the basis of a perceptual judgement. The two pictures appear to be distinguishable, and so some variant of a meaning analysis must have been conducted on these pictures, much in the same way as words are subjected to semantic analyses. Such a conclusion is however speculative, given that no statistically reliable effects occured in the spider card sets. The general failure of the task to work, may mean that it is currently not sufficiently sensitive to distinguish between these two stimuli.

Word stimuli.

To assess the difference in responses to pictures and word stimuli, a second part of the experiment was designed. This involved fewer categories of stimuli, because the spider-like plant stimuli were deleted.[9] Pilot work for this first experiment made it obvious that a smaller between centre stimulus positioning was necessary. This distance between word centres became 63 mm. This large card pool was split into two parts, in the same way as the picture tasks were.

Using words within the same task design, tests the validity of words in interference tasks. The presentation of words in this pattern does not facilitate strategies of switch attention between all of the stimuli.

Hypotheses

1) The word stimulus task should produce similar effects to the picture task, if words are in fact a useful stimulus type in the present method of display.

[9] It was not considered appropriate -at the time -to study words that looked similar to other words, in the context of an experiment based on stimulus meaning and/or relevance . It may prove to be an interesting test though.

Method

Stimuli

Four categories of stimuli were used for the word trials. These matched those used on the picture experiments. These were spider, people, objects, and flower and/or gardening words. (See **appendix 3**) The stimuli were placed into the card arrays similar to the pictures. These words were chosen from Kucera, and Francis (1967), and were selected to have a range in word usage frequency of level 5. This was necessary to enable sufficient numbers of relevant words for the people, and flower categories. The words used w still more similar in frequency of usage than any set mentioned in previous research. MacLeod, and Mathews (1991; p 604) used words differing by no more than 10 occurrences per million- as rated by the American Heritage norms. Word stimuli had a mean visual angle of 1.8° in height, and 5.3° in width. The card width was 12.33°.

The words were laid out on a square that measured 63 mm between centres. This size was chosen to allow subjects to see all of the stimuli, and yet not have words running together to form one larger word. The limiting factor for the distance between words was the separation needed between the borders, which was made to be 5 - 10 mm. If any closer, the borders would have over-lapped. Word cards were divided to give two pools .

The types of probe condition used for the word trials were the same as experiment 1-

Probes corresponding to the conditions of Threat, Interference, No-threat, Dwell, and Repeated were realised by the arrangement of the words on cards.

The spider-like plant category used in the picture experiments could not be replicated in the word experiment, because it seemed nonsensical to use words that look similar to, or are homophones of spider words. Apart from this, the design was the same as for the previous picture task.

Design

Each category of words was divided into the six short, and six long words. These then appeared on separate halves of the 12 cards produced, so that the cards 1 to 6 consisted of combinations of the six shortest words, and cards 7 to 12 the longest. This increased the pairings of words, so that not every combination of category words was displayed. This was necessary to keep the words presented on each trial a similar length, in order to control for longer words having a visual impact and causing a distraction effect in itself.

Results

The means from six phobics were compares with eight experts for these analyses. One subject from each group was not tested on the word task, because they were from a d cultural background, and it was considered that word discriminations may not be a wholly appropriate task for them to participate in.

For all card trials the error rates for phobics was 2.27%, and the experts 2.18%.

Repeated Word

Figure 11 presents the group mean first- and second- border timed for each category of word. Standard deviations for the various categories ranged from 67-103 for phobic subjects of the first border. The corresponding values for experts were 50-134 ms. Second border standard deviations ranged from 64-108 ms for phobics, and , and 68-86 for experts. Separate groups x word category analyses were performed on the first- and second- probe data. There were no significant effects.

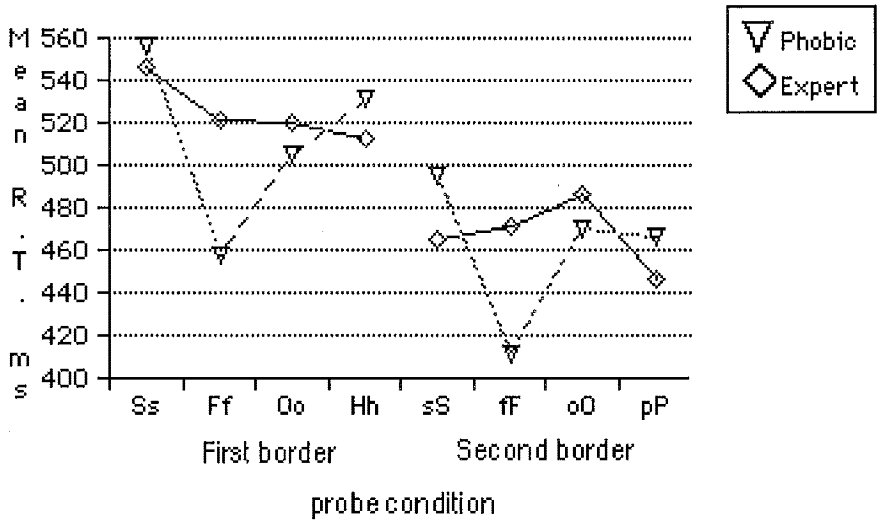

Figure 11. Experiment 2. Group mean first and second border location times for repe... word trials.

Multiple valenced cards

First probe

Group mean first border location times as a function of probe condition are presented in Figure 12, separately for each word category set . Standard deviation ranges were 60-106 ms for phobics, and 80-111 ms for the experts. Interference stimuli appear to cause different probe responses, but no consistent trends emerge.

A groups x word category x probe condition ANOVA indicated that there were no reliable effects.

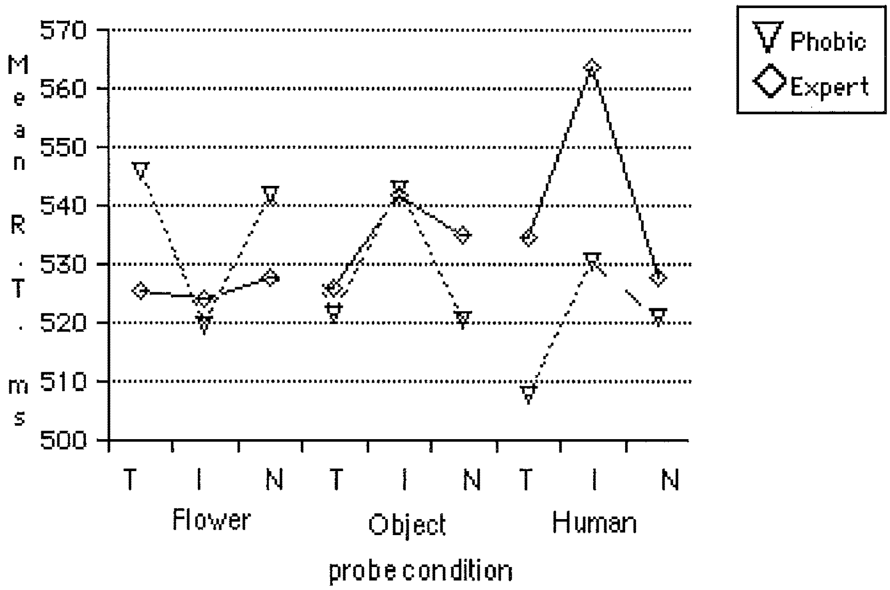

Figure 12. Experiment 2. Group mean first border location times as a function of word category and probe condition.

Second probe

The group mean data presented in Figure 13 do not show any consistent trends. Statistical analyses involving a group x card set x probe condition ANOVA found no significant effects. Standard deviation ranges were 85-115 ms for the phobics and 76 - 103 ms for the experts.

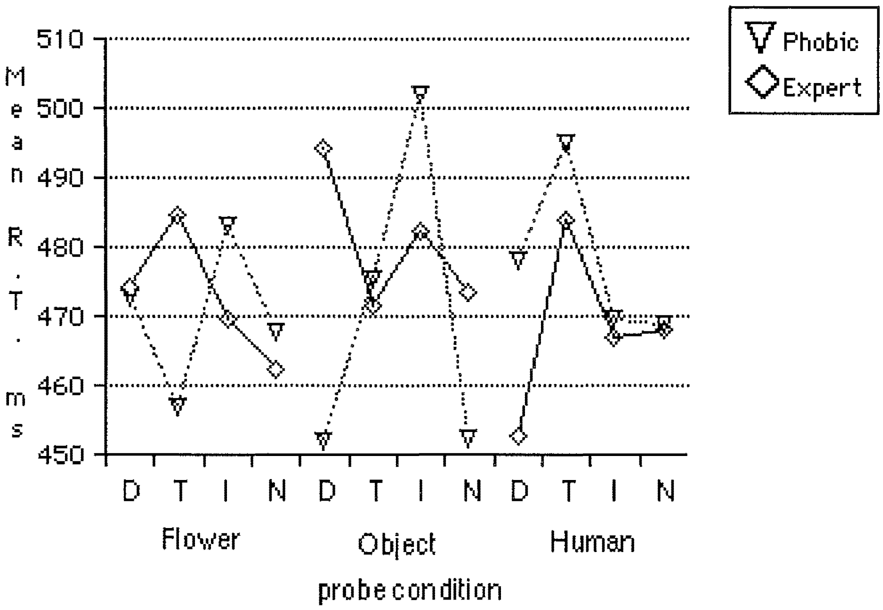

Figure 13. Experiment 2. Group mean second border location times as a function of word category and probe condition.

The obtained trends from first and second border conditions provide no support for the original hypothesis that phobics, and experts would have faster location times when spiders were probed, and that responding after a spider was probed would slow the next location response time.

The lack of any effects within this task, indicate that within the four stimulus border location task, word stimuli are insufficiently visible, or salient to alter the attention of phobics, or experts.[10]

Word stimuli are not discriminably separable, as all appear within a relatively consistent rectangular shape. Therefore the interference tasks designed by MacLeod and Mathews, must be based on subjects being alert to both stimuli. Fox (1993) explained the dot-probe task as resulting from subjects being able to switch attention from both stimuli, because they were both within a central focus of attention. In addition to Fox's interpretation, it can be

[10] It was pointed out to the Experimenter by a research assistant, that from experimentation she had been involved, in words need to have a short word length if they are to be read when displayed in such a task. Smaller word lengths would of course influence the discriminability of word stimuli. The present word task used relatively long words, which provides a possible reason for no effect occurring.

p[posited that the stimuli are scanned, and the stimulus considered relevant is then concentrated on - thus causing the speeded detection of the following probe.

Peripherally presented stimuli.

The border location task was again used, with neutral card arrays only. The interference stimuli were peripherally presented stimuli positioned on either the left or right side of the screen. These varied in threat valence being either spider or flower pictures, or having no peripheral picture. If as Fox (1993) believed, the phobics were generally more likely to be distracted by these stimuli, then the presentation of either stimuli would interfere with central task. The interference would vary, in that an interference stimulus would slow border location responses. The effect of a threat interference stimulus would be a delay larger than that produced by a neutral valence peripheral interference stimulus. For the expert subjects no interference effects are expected.

Two design features make these tasks worthy being tested. Firstly these tasks take the least amount of time to complete, and so are more comfortable for subjects to participate in. Secondly, the distracting stimuli are spatially separated from the primary task of border location. This provides the strictest test of the distracting influence of the stimuli.

Design

Peripheral distracter cards

The border location task was used, with the independent variable of the presence of distracting stimuli varying by type (spider, flower or none) and position (left or right edge of the screen). Individual pictures of the same type as those used on the screen edge, were not used as peripheral

A parallel word task used the neutral cards from the word stimulus task with additional peripherally presented words. If the task was successful in producing an interference effect, it was expected to be larger than that obtained in the previous picture task, because of the way that words need to be scanned . Response differences could be due to biases in the way subjects "read" or scan the stimulus array. If a reading effect occurred it would be more noticeable in the conditions where a stimulus appeared on the left side of the screen. Again threat stimuli would cause the largest effect to be seen in the phobics.

Method

Stimuli

The task displayed the full set of no-threat cards, from the picture and word tasks.

The peripheral picture stimuli were all of the pictures from the spider and flower categories, reduced to a size of 25 mm^2 . They were positioned 15 mm from the outer edge of the no-threat pictures, on the central horizontal axis .

For the word version, the flower and spider words were the same font size, and layout as the central word stimuli, with the peripheral word placed 15 mm from the outer edge of the no-threat words.

The spider and flower words could appear to the left or the right of the target set, then giving four peripheral conditions. A fifth condition termed neutral, presented as a central condition the neutral cards without any peripheral stimuli.

Each condition consisted of 12 cards, except that there were 24 neutral cards.

The best method would have been to use all 12 border locations (referred to in Table 2), and each of the four categories of peripheral stimuli, for each of the five card types. To keep the numbers of trials to manageable numbers, only 12 cards selected at random were used for each peripheral condition, i.e. 12 cards across all 12 x 4 peripheral conditions.

Picture stimuli.

Data was obtained from four phobics, and five experts. Due to the difficulty of obtaining expert subjects, only half of the group completed this task, while the other half were tested on the peripheral-word distracter task. Therefore these data can only be considered a pilot, as only five experts were compared with four phobics.

Error rates over all trials for phobics was 8% (due to a large number of errors by one subject), and for the experts was 3%.

Group mean times to locate the first border around neutral stimuli in the presence of spiders, flower, or no peripheral stimulus, are presented in figure 15. The data were treated by a groups x distracter type (spider left, spider right, flower left, flower right, no distracter) analysis of variance. There were no significant effects.

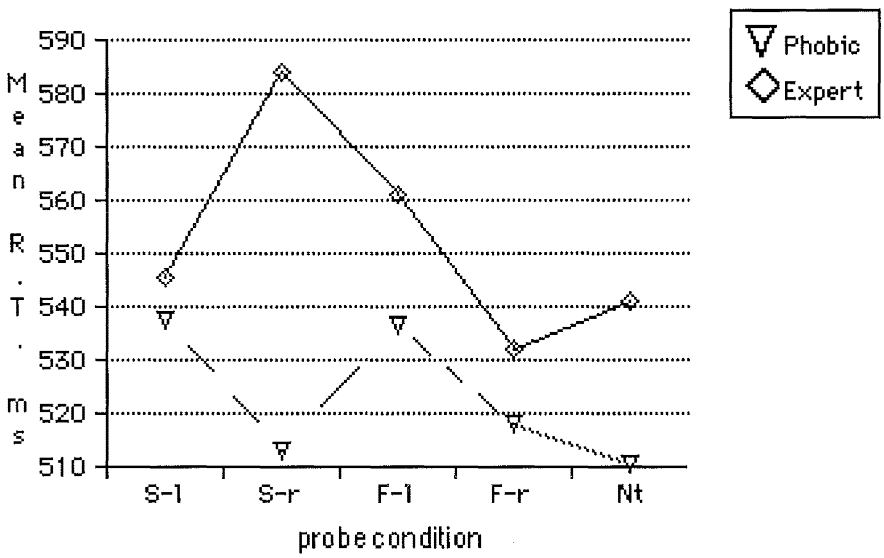

Figure 14. Group mean first border location times to neutral stimuli, as a function of peripheral picture distracter.

Corresponding results for the second border around a neutral picture are presented in Figure 16. Again, an analysis of variance revealed there were no significant effects.

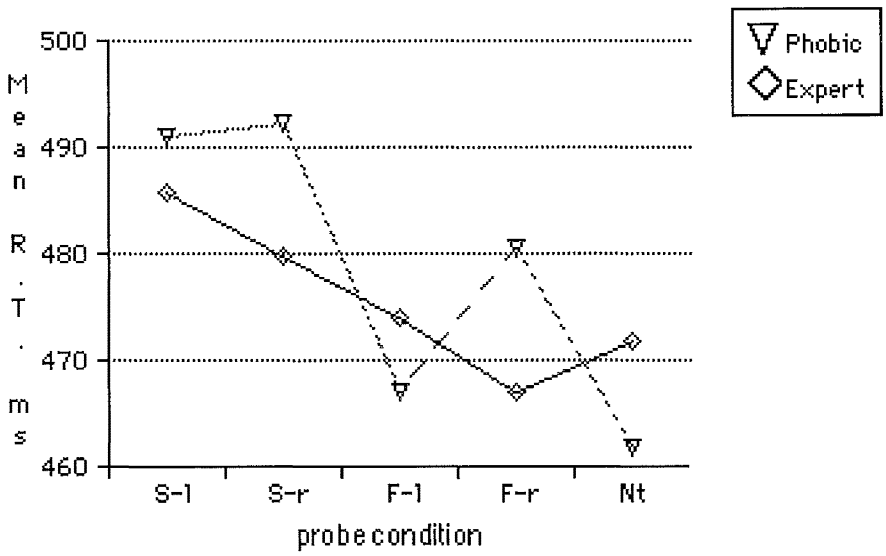

Figure 16. Group mean second border location times to neutral stimuli, as a function of peripheral picture distracter.

Word stimuli.

Data was obtained from two phobics, and three experts. Error rates over all trials for phobics was 2.08 % , and for the experts was 1.2 %.

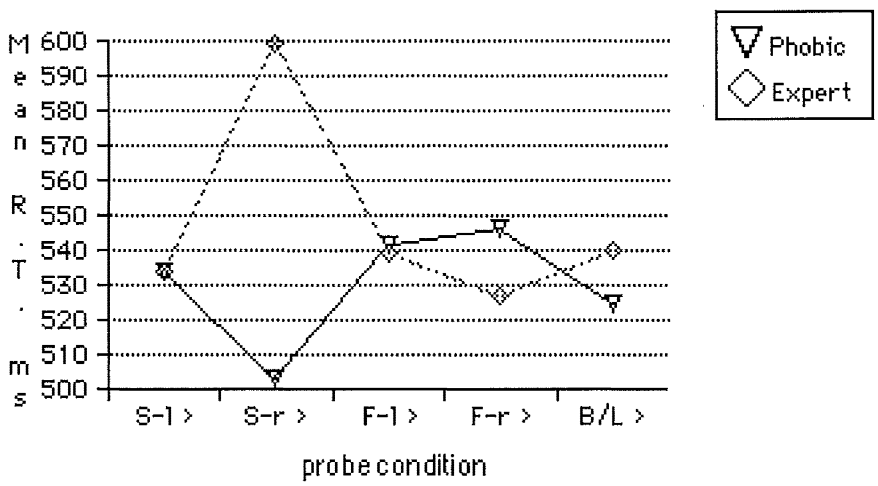

Figure 17. Group mean first border location times to neutral stimuli, as a function of peripheral word distracter.

When the data were subjected to a groups x distracter type ANOVA, no significant differences resulted. Again the lack of subjects could have produced in this, as only three experts were compared to three experts.

Second probe

The phobic group responded slower to peripherally presented spider words, and fa: flowers , as evidenced by the difference to baseline trend, in figure 15. Compared to baseline performance, experts responded faster to all stimuli except when spiders appeared in the right periphery.

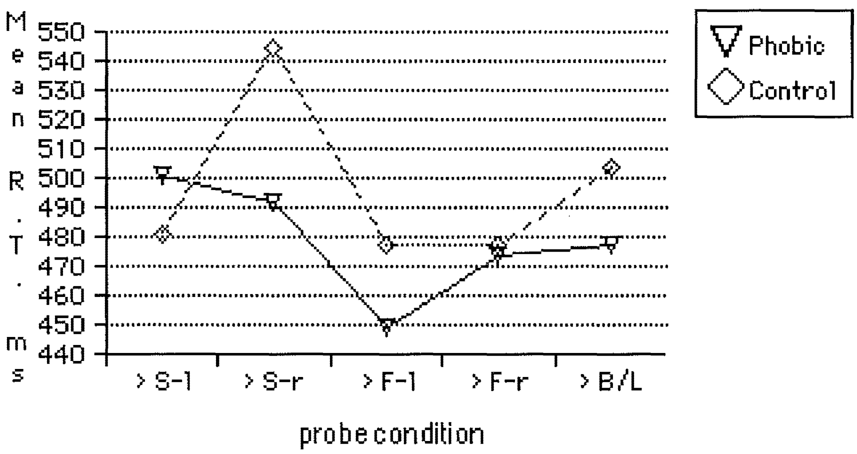

Figure 15. Group mean second border location times to neutral stimuli, as a function of peripheral word distracter.

Peripherally presented stimuli discussion.

The present two peripheral stimulus tasks intended studying how powerful the distracting effect of additional stimuli can be for phobic, and expert subjects. No consistent trends emerged from either task, suggesting that stimuli presented outside the central area of attentional focus, do not interfere with the border location task. A statistically reliable pop-out effect for preipherally presented distracter stimuli was not obtained, for either the picture or word task.

These results are moot in relation to supporting or contradicting studies expecting interference stimuli pop-out effects.

The magnitude of differences in responses to the probe conditions in Experiment : not match those seen in Experiment 1. Therefore additional experimentation is needed to ensure that the method of presenting the Picture cards task is correct. This is the intention of the following section.

EXPERIMENT 3.

Introduction

Two explanations can be posited for Experiment 2 failing to replicate the effects found in Experiment 1, where phobic subjects were distracted by spider stimuli. The first relates to the division of the stimuli into two card sets. The current experiment involves a pilot investigation to establish the causes of this discrepancy between Experiment 1, and Experiment 2. A small number of subjects were given both halves of the picture task used in Experiment 2, and tested with the same computer monitor.

Secondly , as noted in the introduction to Experiment 2, there was a difference in probability of probe occurrences in Experiment 1, due to the dysphoric category not being probed . In an attempt to reproduce this aspect of Experiment 1, a second task in the present experiment used Flowers as the redundant category.

In a further attempt to explore the effects of a reduced number of probed stimulus categories, a final task consisted of trials which displayed only three pictures on each card. That is, rather that containing a picture category that was never probed, one corner simply contained no picture at all, which was never probed.

If the two redundant stimulus tasks yield larger speeding to threat effects than the complete picture task, then the results of Experiment 1 may have been artifact of the redundant dysphoric picture category.

Hypotheses

The central hypotheses of this current experiment were -

1) On the standard four picture task, phobic but not control subjects will show an interference effect for threat stimuli, as was found in Experiment 1.

2) The task having one redundant picture will produce response time trends of a similar relevant magnitude.

3) The task having one redundant picture corner, will produce a larger response characteristic trends from spider picture influences than occurred in both the picture, and redundant picture tasks.

Method

Subjects

A small set of women psychology postgraduate student subjects participated in this experiment. They were not specifically questioned but accepted as being approximately age, and education matched.

The performance of three arachnaphobics (mean Spider Questionnaire score of 18.67), was compared with two control subjects (Spider Questionnaire score of 10). Such a small sample size was chosen, because it was hoped trends would emerge after testing these people.

Design

The design of this task was the same as Experiment 2, except that there were no spider-like plants presented as plant-threats.

Stimuli

The first task of the present experiment was a replication of the picture task from Experiment 2.

In addition, two further tasks were included.

The first of these contained a redundant picture category - flowers - that was never highlighted by a border. Stimulus cards consisted of pictures of the spiders, objects, human, and flowers that appeared in the previous experiments. (See table 3).

The probe conditions used were ;-

1) first probe threat (Cards 1 - 24)

Second probe threat (cards 25 - 48)

2) first probe interference (cards 25 - 48)

Second probe interference (Cards 1 - 24)

3) the no-threat (Cards 49 - 72)

Table 3. Probe conditions for the two redundant stimulus tasks .

card number	first border [1]	second border [2]	filler i R.P	i E.C.	stimuli ii
1 - 12	S	H	F	---	O/H
13 - 24	S	O	F	---	O/H
25 - 36	H	S	F	---	O/H
37 - 48	O	S	F	---	O/H
49 - 60	C	O/H	F	---	O/H
61 - 72	P	O/H	F	---	O/H

Note for the filler stimuli column, R.P signifies Redundant picture, and E.C means Empty card corner. O/H denotes that either object or human pictures were randomly chosen to appear in the second filler position for the Redundant picture task, while in the Empty corner task the same type of picture was used as second border, and filler.

The third task had one picture erased (the object category), so that only three pictures appeared on a stimulus card. This empty corner was never probed by a border. As a further difference, the No-threat cards had only two categories of pictures presented. These cards consisted of one picture of either the flower or human category, and two pictures of a second category (humans or flowers respectively). The first border surrounded the single picture, and then moved to one of the two remaining pictures. The card array layout governing this move made it so that the border had to occur in a second position that had pictures on both sides of the screen. This was to stop the learning of the simple rule that once one hand had pressed a key, then the other hand would be likely to respond next. (See Fig 19.)

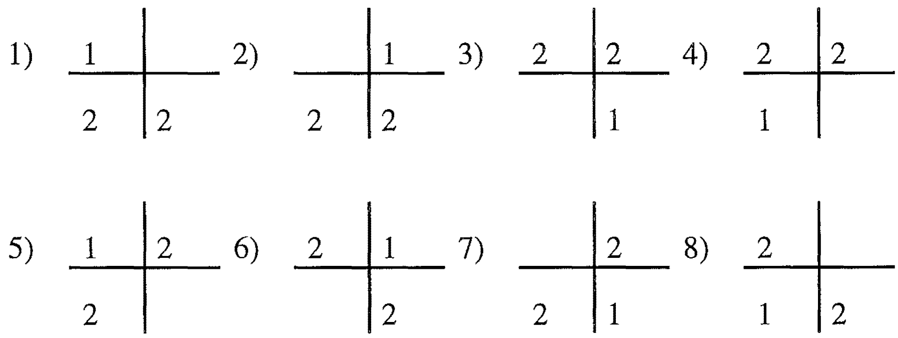

Fig 19. The array layouts used for the missing picture task, to ensure that on the seco half of the task, subjects do not respond on alternating hands for each probe appearance. This does result in repeating some array layouts, thus only eight are drawn.
Note: The values 1, and 2 refer to the respective areas where first and second borders may appear.

Apparatus

These experimental tasks were conducted in the same auditory lab, again using the Macintosh L.C. II computer, and Philips 9CM080 15 " colour screen.

The Watts et al (1986), Questionnaire of dimensions of spider phobia was again issued as the phobia rating scale.

Procedure

The procedure was the same as Experiment 2, except that subjects were told that there would be four experimental tasks, each lasting for approximately 10 minutes. Prior to participating in any of the tasks, subjects completed a consent form, and read the instruction sheet. Spider phobia rating questionnaires were given between the four picture, and redundant stimulus tasks, to act as an additional rest period.

Results and Discussion

Error rates over all card trials were for the phobic group 2.14%, and for the controls 1.04 %. Standard deviations for both border responses ranged from 73 - 145 ms for the phobics, and 81 - 147 ms for the controls, and did not vary systematically for particular probe conditions.

Repeated picture cards

Group mean first- and second- border location times, are expressed in Figure 20. There is a tendency for the phobic group to respond faster to both first and second borders, when they probed spider stimuli.

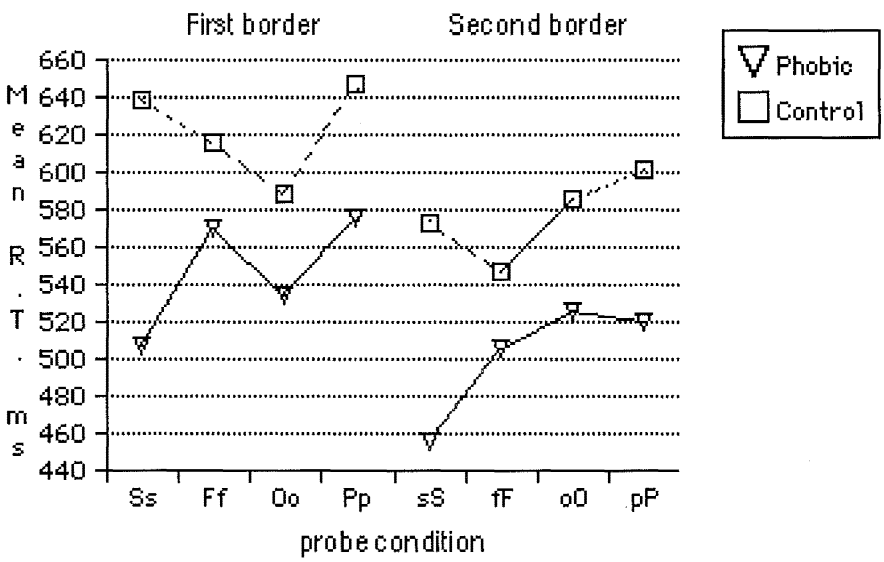

Figure 20. Experiment 3. Group mean first, and second border location times as a function of different probe condition on repeated picture cards.

A first border groups x probe condition ANOVA, confirmed this trend, with a main effect for probe condition $F\ (3,9) = 5.30$, $p < 0.05$. When similarly analysed, the second border response trend indicated a significant probe condition main effect, F $(3,9) = 6.66$, $p < 0.05$.

The two groups responded with similarly shaped border location response time trends, except that the phobics speeded to borders occurring around spiders. While the location times were generally greater for the experts, the trends across the various neutrally valenced categories were the same for phobics and experts alike.

Multiple valenced cards, and Redundant stimulus card tasks.

The three tasks in Experiment 3 were treated by similarly designed statistical analyses as previously used in Experiments 1, and 2. Response time trends did follow the expected patterns, however due to the small number of subjects participating in this set of tasks no significant effects emerged. This data will therefore not be reported further. (These ANOVA summary tables can be seen in Appendix 5, and the border location time graphs are presented in Appendix 4.)

Response times for each group were collapsed across card sets to give mean location times for each probe condition. These plots are presented in figure 21.

Results of Experiments. 1 , 2 , and 3.

To assess whether the response characteristics of groups conformed to consistent patterns, probe conditions were collapsed across picture sets. Each of the three experiments is summarised in Figure 20 and Figure 21, for first and second border location times respectively.

Only Experiment 1 data displayed statistically reliable effects, for the first border Threat probe condition. The second border collapsed card data resulted in a significant difference for the Interference condition, and was very nearly significant for the threat condition described by the Dunnett test, described in the results of Experiment 1). All other response trends displayed in Figures 20 and 21, are therefore suggestions of an effect expected to have occurred. The similarity of all the trends defies coincidence, and, speculative as such a suggestion may be, appear to imply a robust underlying cause.

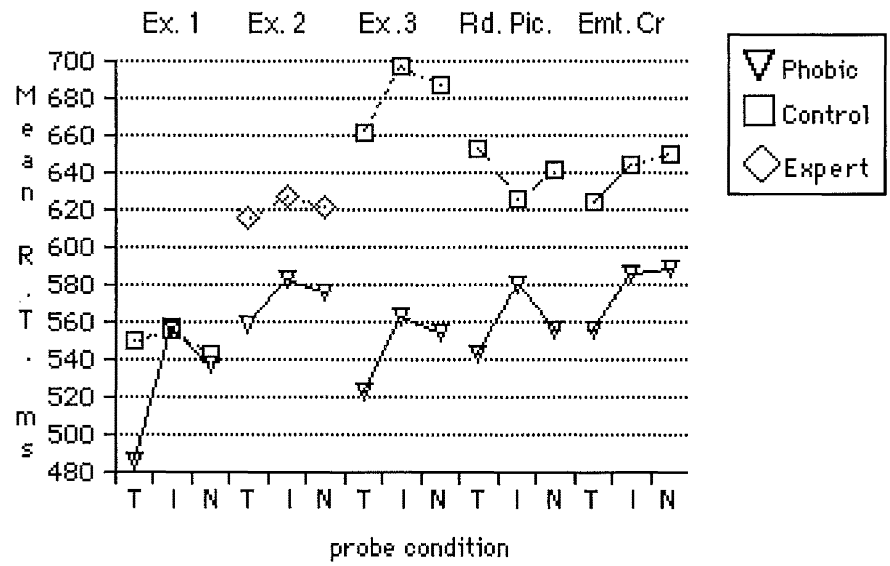

Figure 20. Experiment 3. Group mean response times for averaged picture-sets, as a function of first border probe condition.

The trends of response time data in Figure 20 suggest a fairly consistent pattern of responding on the part of phobic subjects. That is, there is a general tendency for location responses to be made faster to spider probes. Unfortunately the control subjects show similar response characteristics.

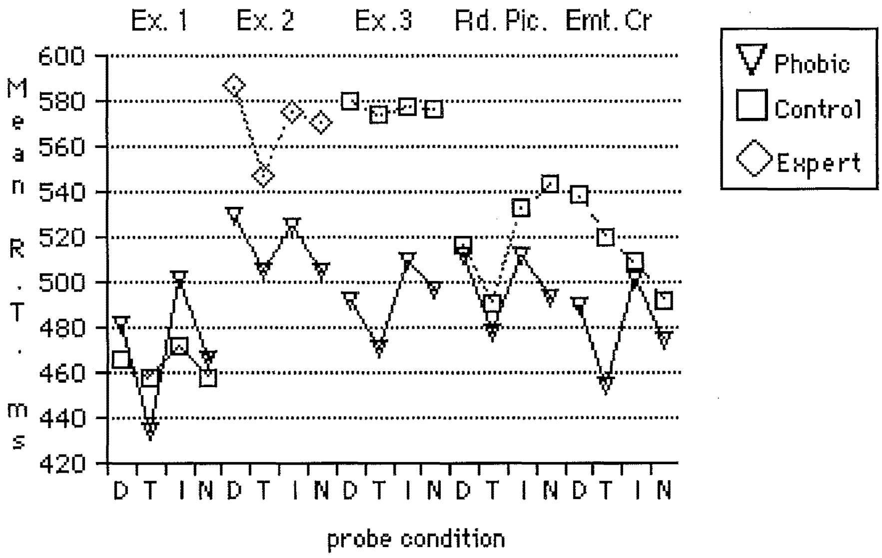

Figure 21. Group mean response times for each second border probe condition, averaged over all card sets.

When second probe data are considered, a clearer difference between the groups, in the pattern of location times with probe condition emerges.

In all five situations depicted in Figure 21, phobic subjects display a characteristic distraction from- and speeding to - spider pictures, and this pattern is also found in the data of the spider experts in experiment 2. The data of the control subjects tends to suggest equal location times across probe conditions, except for the Empty corner task of Experiment 3.

Overall the border location response time trends are consistent for phobics, and different from controls. However, no firm conclusions can be drawn from the data, as no statistically reliable evidence was obtained from either Experiment 2, or Experiment 3.

Given that the probe condition effects on location time are of a small magnitude, and that Experiment 3 was merely a pilot study, some tentative generalisations about the border location task may be offered. When the response time trends are considered, there does appear to be support for the robustness of the Border location task. The data obtained from subjects who participated in only half of the Pictures card-set (Experiment 2), produced response time trends similar to those obtained when subjects complete all of the Pictures card-set (Experiment 3.) Therefore, the lack of a large effect in Experiments 2, would not appear to be due entirely to this measurement technique.

Secondly, trials involving a redundant stimulus (the Redundant stimulus, and Empty corner tasks of Experiment 3) did not result in response time characteristics differing fı those obtained in the first task of Experiment 3 - which involved four probed pictures. This would suggest that the effects found in Experiment 1 were due to the attentional alterations caused by the presence of the spider stimulus, and not a product of altered probabilities of where the probe is likely to occur.

GENERAL DISCUSSION

Discrepancies between Experiment 1, and Experiments 2 and 3, would not appear to be caused by the separation of the longer task into two halves. Secondly, the use of the No-threat cards used in Experiment 1, which were of a different design to other cards, would not seem to have altered the effects obtained in the first experiment. No-threat location times in Experiment 1, were similar to the repeated picture card values within each border condition.

The pattern of results obtained in the Experiment 1, could have been explained by referring to the differences in homogeneity among pictures in each category. Within all experiments, picture sets contained the came stimuli, but were arranged to be probed in a different way. Considering Experiment 1, the lack of homogeneity in the Every-day item category, could have created a within-card context, that caused the spider stimuli to be more visible. The discriminability of individual stimuli, as assessed by the repeated picture test, does not relate to the relative discriminabilities that stimuli have when they are presented on multiple valenced cards. That is, if the spiders are a single stimulus, from one class, while the objects are more varied, then relative to the context of that card, the spiders may appear more distinguishable. This could have increased the phobic groups response speeding, which was found on Threat probe conditions. Similarly if the Plant and Spider pictures are visually similar, and are both treated as threatening, may have resulted in the large response delay shown by phobics in the Interference condition. However, because control subjects did not show an influence in response trend in this situation, the criticism is not justified. Also data from Experiment 2, which used similar picture set - Objects - did not result in any trends for phobics. Similarly Flower stimuli used in Experiment 2 were homogenous, and un-spider like, but an interference effect still emerged.

One possible remaining explanation for the smaller magnitude response trends obtained in the latter experiments is that the use of the larger colour monitor introduced a different stimulus display. The visual angle of the second task was not precisely controlled for, and secondly the Philips 9CM080 15" colour screen is more curved than the Macintosh M1050X 12" Monochromatic screen. This, combined with the increased curvature of the monitor screen, and increased pixel separation may have resulted in the stimuli appearing less defined, and thus slightly less equally visible. The Repeated-stimulus trials do show more variability on the experiments using the larger screen (refer back to Figures 7 and 20), compared to the Repeated-stimulus trials of Experiment 1 (shown in Figure 3.)

First border response times, appear to most clearly display this variation in effect size due as a result in the increased screen size. Experiment 1, used a smaller screen, and displays a statistically reliable effect, where phobics more quickly detect probed spider stimuli. All other response patterns indicate that probe conditions have little influence on the border location responses of either group.

Second border response times are consistent through out experimental tasks, although the magnitude of effect is reduced when the larger screen is used.

Methodological issues.

The obvious methodological improvement of the present series of tasks is to repeat the four picture task of Experiment 3, on the smaller Macintosh M1050X 12" Monochromatic screen, with a reasonable number of spider-phobic, spider-expert and control subjects.

Additional tests of the importance of stimulus relevance would involve selecting different kinds of expert subjects. Within the cntext of a University campus, such groups as Zoology Bird experts could be used. No matter what the group is, a set of cards using pictorial stimuli would need to be constructed and added to the multiple valenced task, that displays stimuli relevant for them. In the case of birds, such a card set would be both a Neutral and Relevant category. This would allow the teasing apart the mediating influence of stimulus relevance and stimulus alerting subjects into either cognitive or physiological arousal states.

A major difficulty is creating stimuli that actually express the category they were intended to describe. The spider stimuli were obviously easy to create, and effeciently performed the function, but the dysphoric set were rather unsatisfactory.

Although word stimuli have been previously criticised, they would appear to conform to conceptual categories more obviously than pictures, and they have the advantage that their appearance does not induce any perceptually based arousal influences. A devious test would be a stimulus relevance test, using word stimuli, and employing anxiety sufferers, compared to controls, and an expert group of Graduate students who have studied Behaviour modification. They would find the terms relating to anxiety, fear and depression salient, and important, although not an aspect of their "idiosyncratic belief system" (Martin et al 1!

The series of tests outlined in this thesis provide no conslusive evidence for or against the conceptualisation of stimulus relevance mediating attentional allocation prioritizations. They do indicate a better design of distraction task, and therefore are of some pragmatic value.

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Appendix 1: Consent form for all Experiments.

CONSENT FORM. For " "Square border" experiment"

Reason for the project: This experiment is meant to help understand the way we react, when we see things that relate to ourselves. It is mainly a test of some models of attention allocation. To you the participant, it will mean in the end that you will be given a graph of reaction time values. This will mean nothing as far as describing what sort of personality you have, or whatever. This is not intended to be an experiment that offers any form of treatment. By completing this task you will in no way be making yourself feel, think, or behave any worse. The purpose is to aid the theoretical development of models that can be used in future research, and therapy, that will in the end help people.

Your tasks in this project: You will be asked to watch a for a square that appears around one , of a set of 4 small pictures on a computer screen, and press one of 4 keys on a keyboard, that match the layout of that picture (that the square surrounds). The time taken for you to press the key will be measured, and recorded.

Risks associated with participation: None

Confidentiality: The data obtained will have no meaning at all, until it is all collected, and compared. Even then it will mean little more than one group being different to another. You can choose a "code name" for describing your set of recorded data. All information will be kept confidential, and only stored/referred to by that code name.

Voluntary participation: If at any stage you feel unhappy with the procedure, or pictures , you may ask to stop . All information relating to your data, code-name, and grouping will then be erased.

Time required: You will need to spend only about five minutes learning to do the task, five minutes filling out a questionnaire, and a further 25 minutes actually doing the tasks. They take 3,15,10,and 7 minutes approx.

Name of researcher: Mark S. Cunningham. Room 405 (Auditory lab) psychology. Phone (home) xxx-xxxx.

Appendix 1: Instruction sheet for all Experiments.

INSTRUCTIONS.

This experiment is a test of how accurate people can be, in noticing a square that appears around some distracting pictures.

The computer screen will show :

- a large "plus sign" (+) for a short time, and this is where you should let your eyes settle, and stay

- this will be followed by four pictures ,that appear in each corner of the screen, in the layout of a square

- around one of these pictures will appear the box shaped border.

It is this box that you are looking for.

Once you see the box, press the key on the keyboard that matches the place where it occurs on the computer screen.

The layout is........... Typewriter key :-

" **A** " is for the top left corner	" **K** " is for top right corner
" **Z** " is for bottom left corner	" **M** " is for bottom right .

-the box will then shift to another position, and you must again press the key matching where it shifts to.

Please respond quickly on each key .

After that key-press, the process repeats until you finish the task. (This will take about .... minutes.)

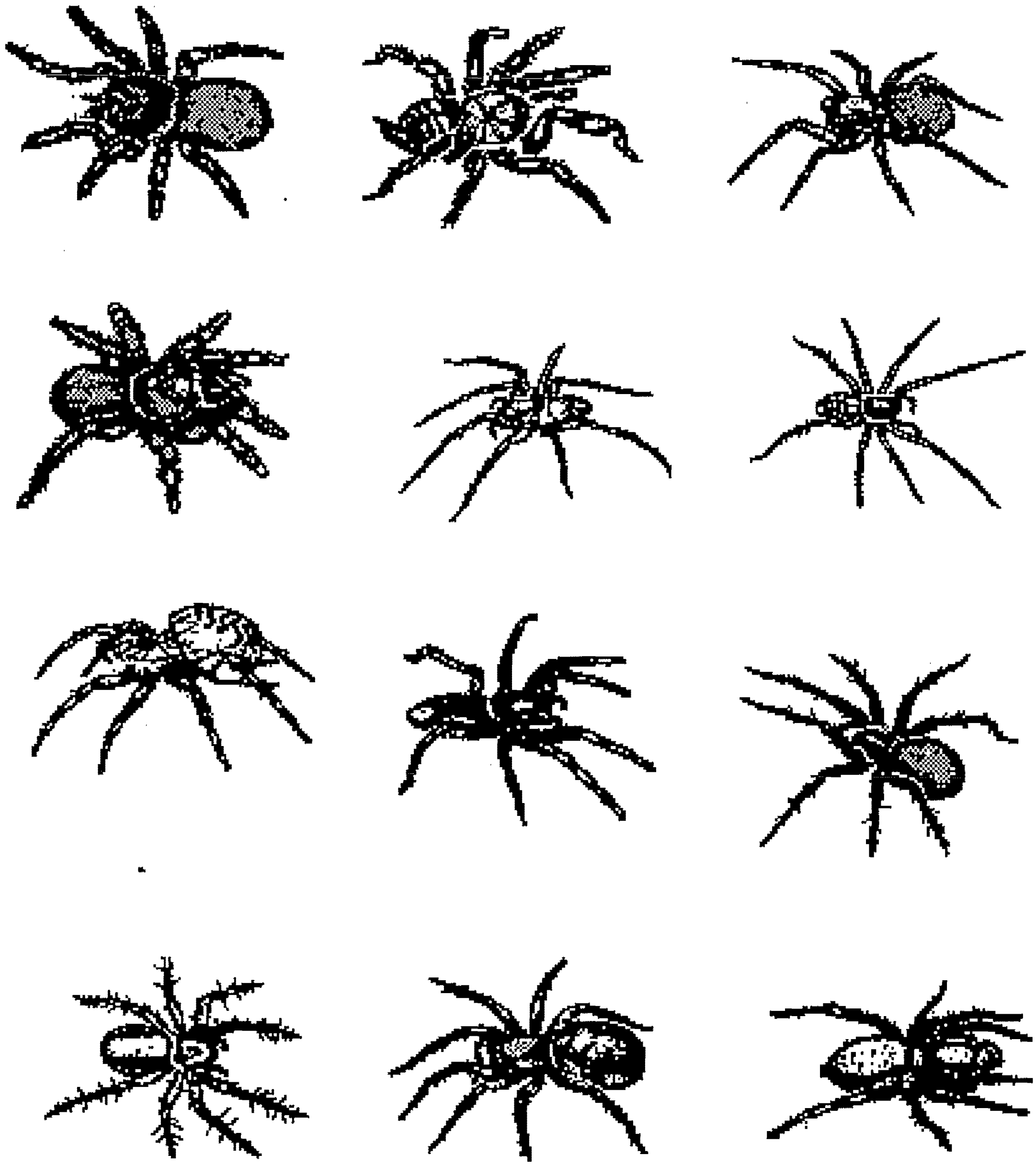
There are four rest phases, that occur about every three minutes;(they are signalled with a "beep", when the screen goes blank). These are so that you can rest, have a good blink, and change the focus of your eyes. They last for 20 seconds, (but feel like they take longer). After that time the program re-starts, - with a "beep" that warns you that the program is about to start again (with the large "plus sign").

You can make rests, by pressing the "space bar" , if your eyes or fingers feel tired, or if you need a scratch, etc.

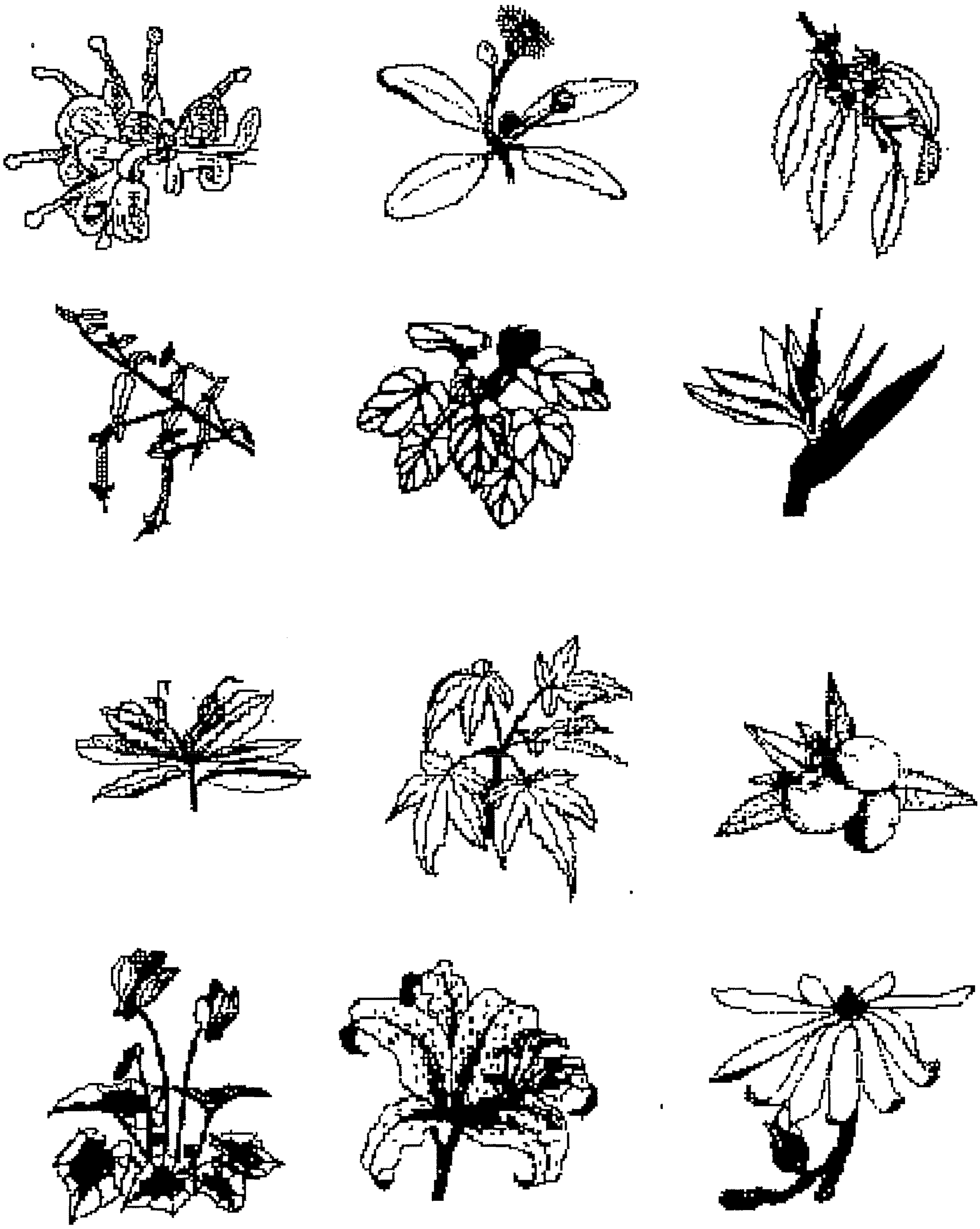
If you find that you do not wish to complete the experiment, then press the " **Y** " key, which stops the program.

There is a short practice program to help you understand these instructions, and get your fingers co-ordinated.

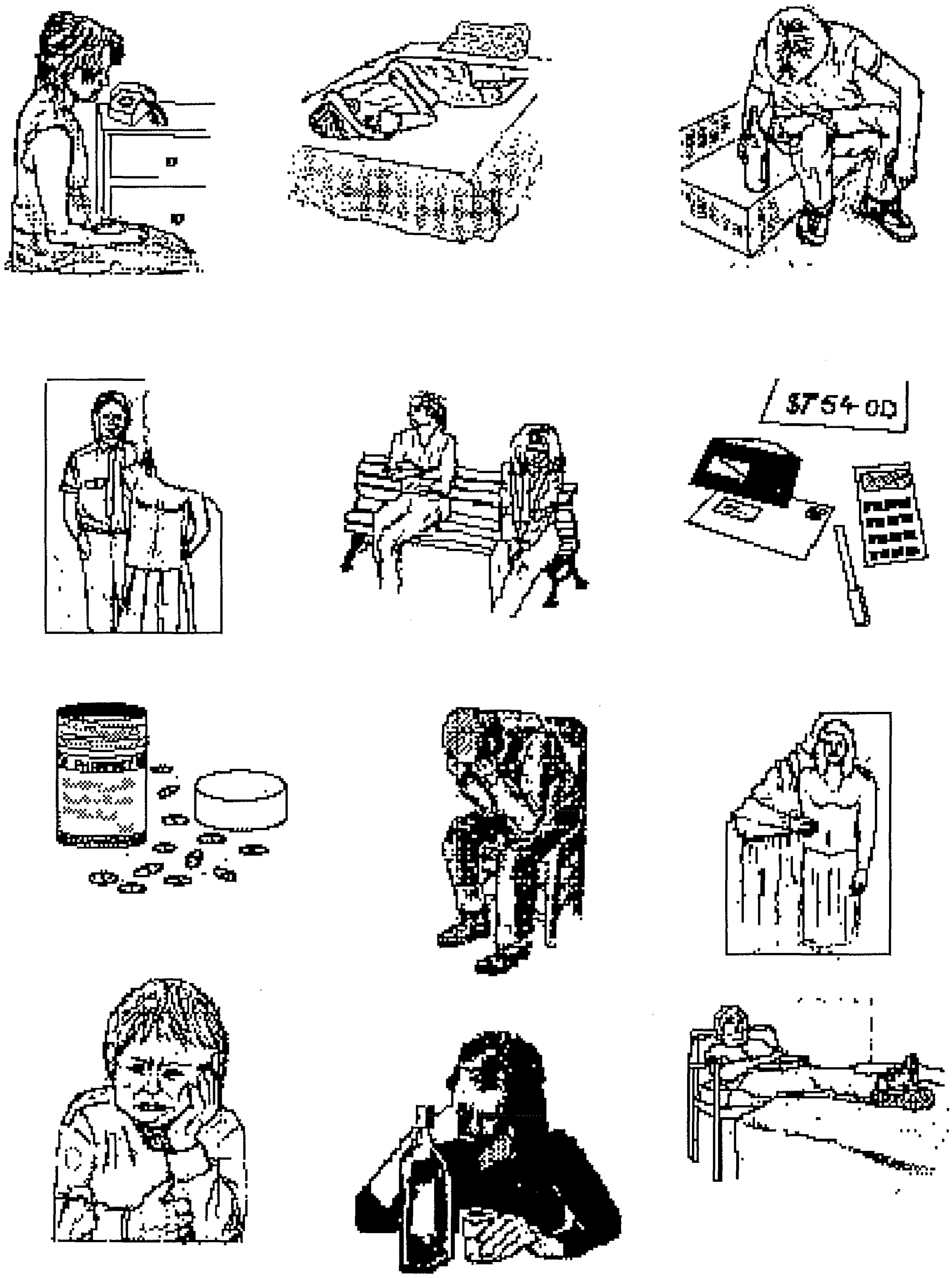
Appendix 2: Figure A. Spider picture stimulu used for Experiments 1, 2 and 3.



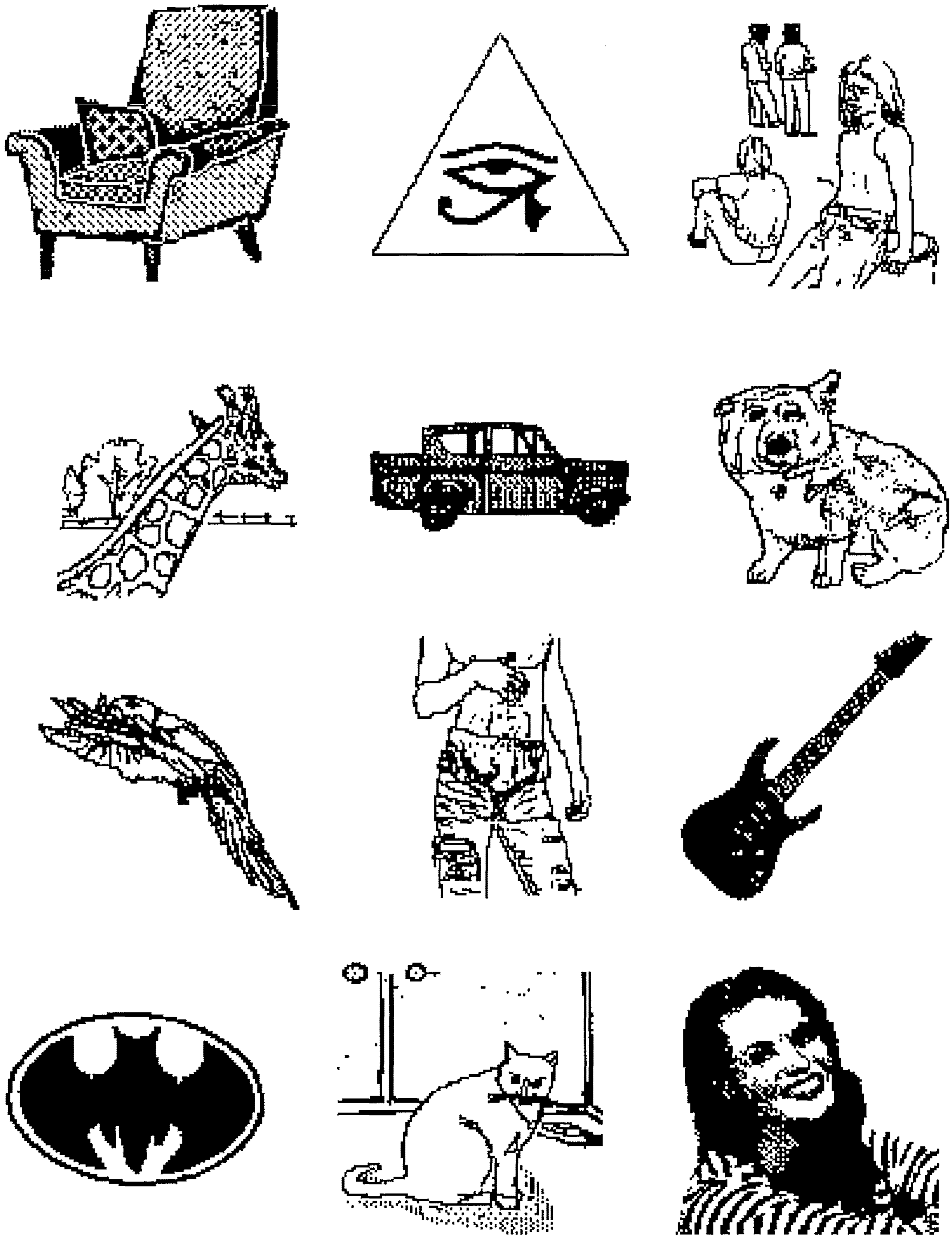
Appendix 2: Figure B. Plant picture stimuli used for Experiment 1. (The upper six pictures were used for the spider-like plant picture set, in Experiment 2.)



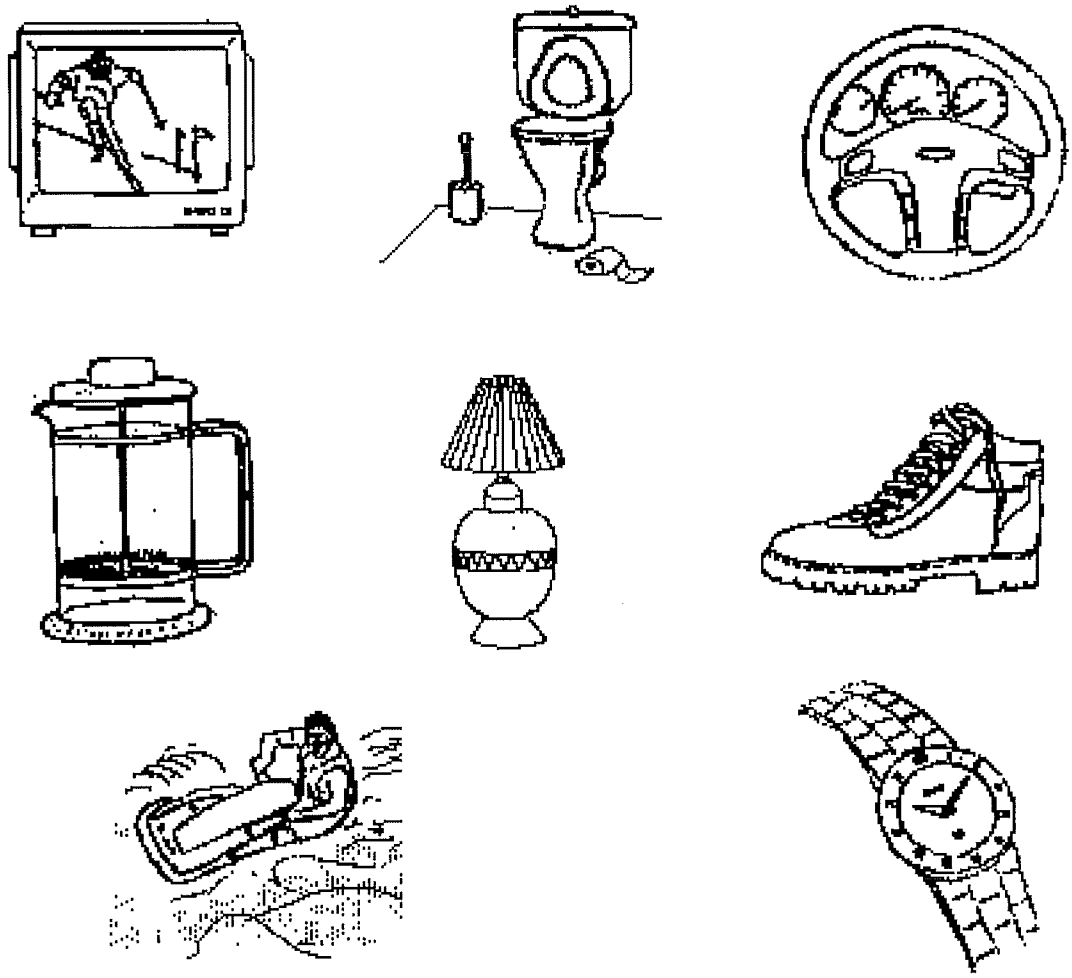
Appendix 2: Figure C. Dysphoric picture stimuli used for Experiment 1.



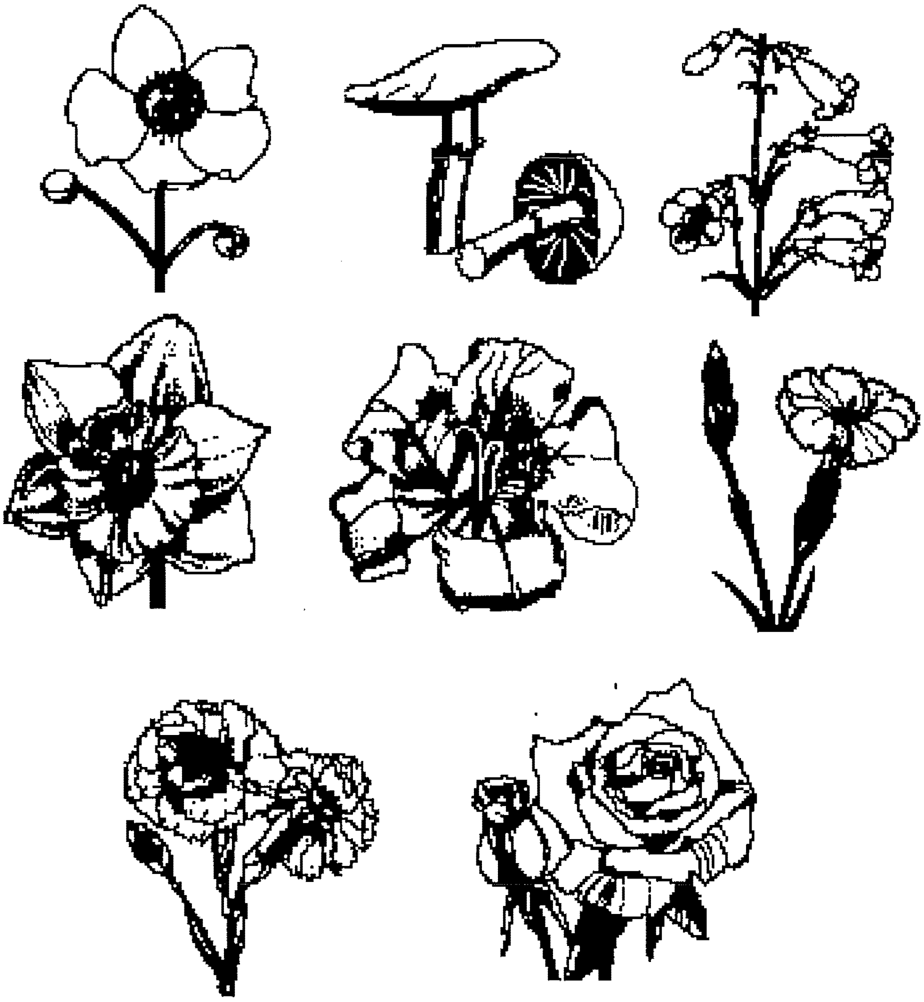
Appendix 2: Figure D. Every-day picture stimuli used for Experiment 1.



Appendix 2: Figure E. Object picture stimuli used for Experiment 1.



Appendix 2: Figure F. Flower picture stimuli used for Experiment 1.



Appendix 2: Figure G. Flower picture stimuli used for Experiments 2 and 3.

Appendix 2: Figure H. Human picture stimuli used for Experiments 2 and 3.

Appendix 3: **Figure I.** Word stimulus categories used for Experiment 2.

nasty	butler	comics
bitten	usher	burger
scary	vicar	photo
venom	loser	poster
dangle	athletes	pillows
spider	foreman	badges
creepy	gardener	handbag
harmful	waiters	buckets
woodshed	doorman	earrings
trapdoor	housewife	albums
sinkhole	plumber	candles
cobwebs	nephews	lipstick
petals	flowered	
floral	rosebush	
lotus	poppies	
tulips	orchids	
lily	daisies	
lilac	nectar	

Appendix 4: Border location time graphs, Experiment 3.

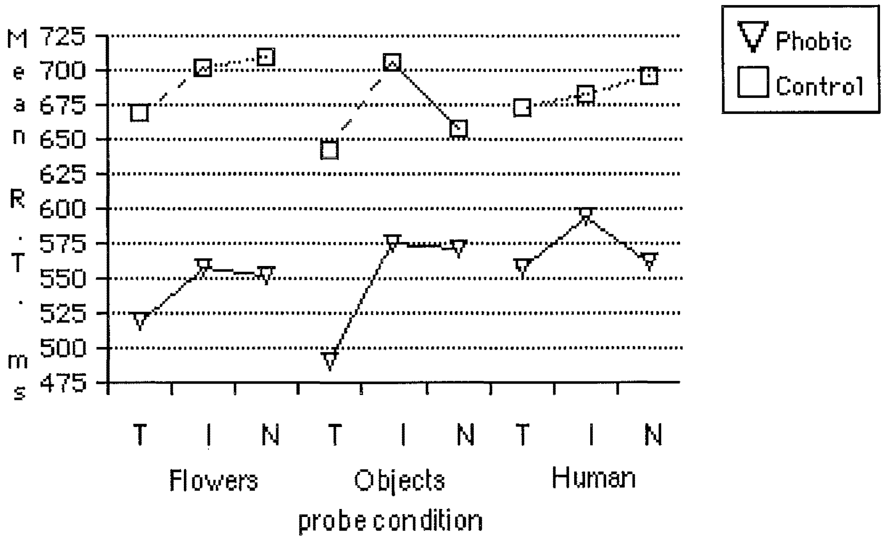


Figure a. Experiment 3. Group mean location times for first border responses, as a function of picture set.

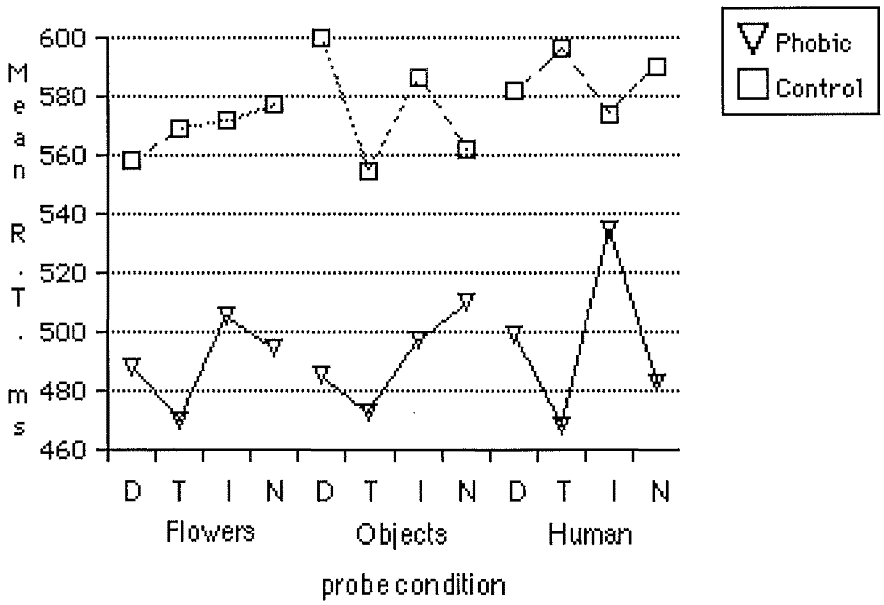


Figure b. Experiment 3. Group mean location times for second border responses, as a function of picture set.

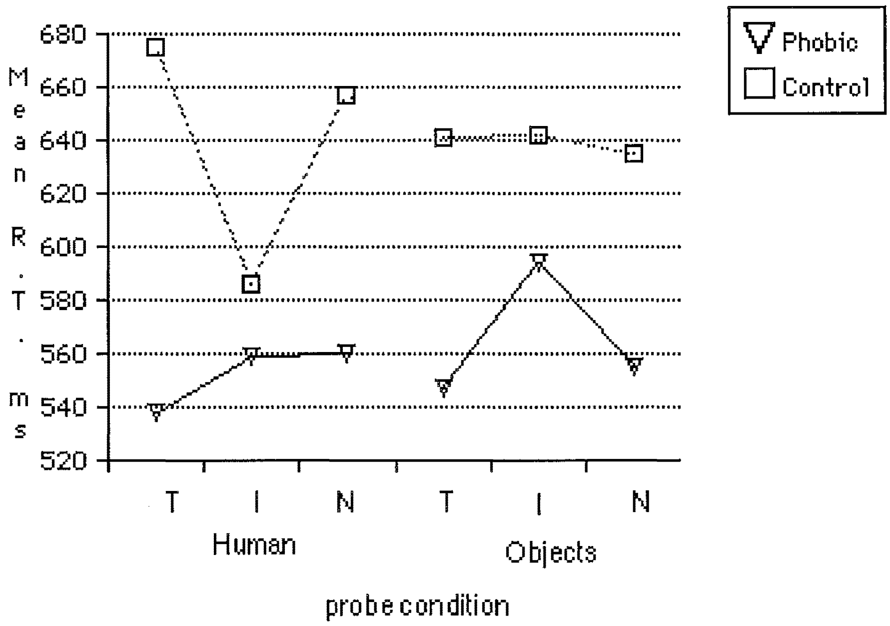


Figure c. Experiment 3, Redundant picture trials. Group mean location times for first border responses, as a function of picture set.

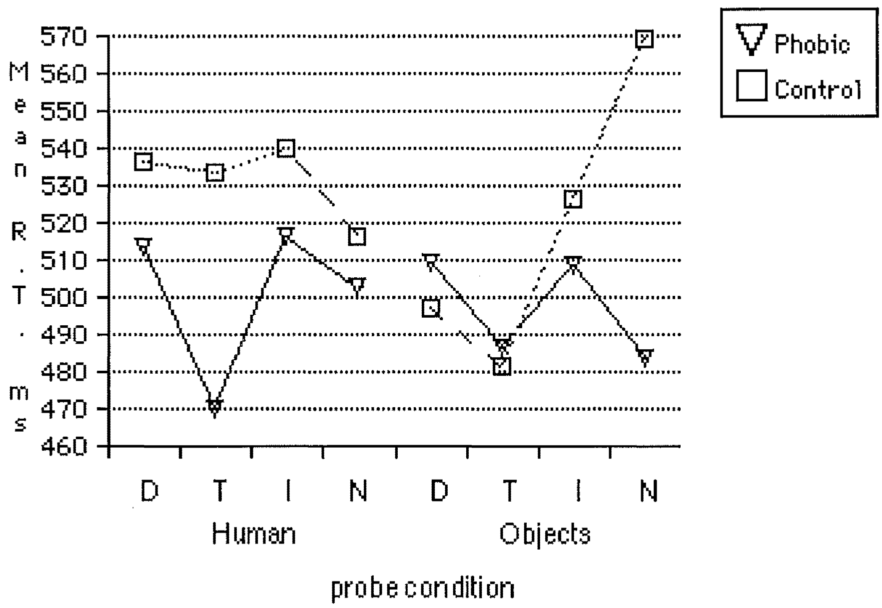


Figure d. Experiment 3, Redundant picture trials. Group mean location times for second border responses, as a function of picture set.

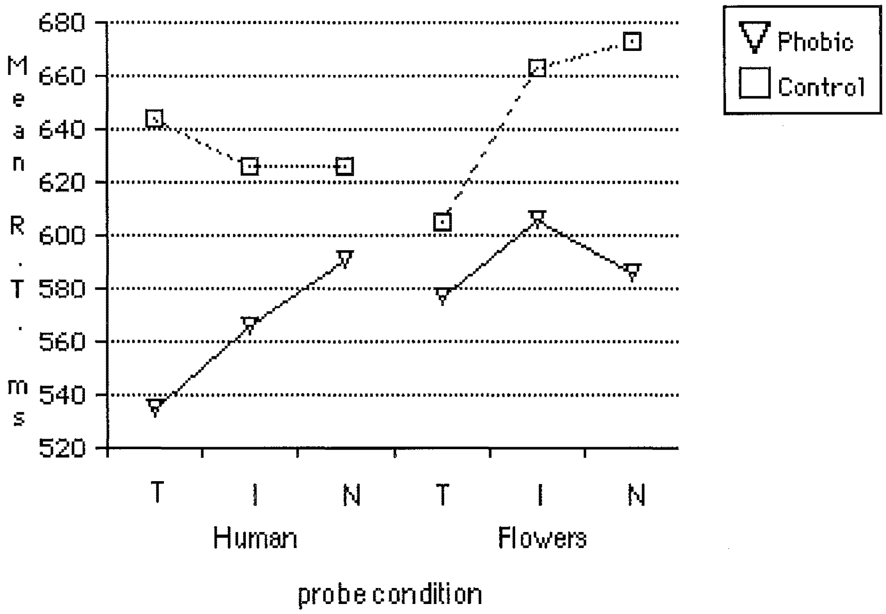


Figure e. Experiment 3, Empty corner trials.
Group mean location times for first border responses, as a function of picture set.

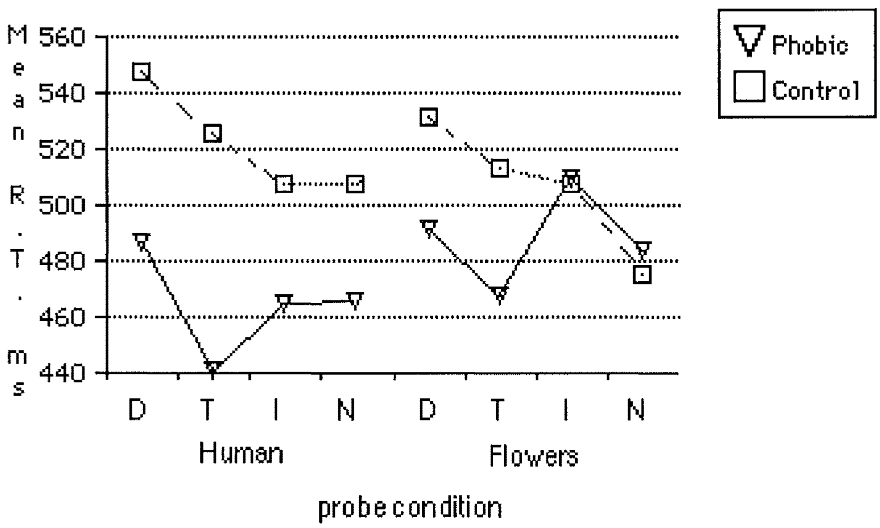


Figure f. Experiment 3, Empty corner trials.
Group mean location times for second border responses, as a function of picture set.